TRANSACTIONS

OF THE

KANSAS ACADEMY OF SCIENCE

Volume XXXII

Sixty-first Annual Meeting
April 25-27, 1929

Kansas State Agricultural College
Manhattan, Kansas

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CONSTITUTION*

SECTION 1. This association shall be called the Kansas Academy of Science.

SEC. 2. The objects of this Academy shall be to increase and diffuse knowledge in the various departments of science.

SEC. 3. The membership of this Academy shall consist of three classes: annual, life and honorary.

(1) Annual members may be elected at any time by the committee on membership, which shall consist of the secretary and other members appointed annually by the president. Annual members shall pay annual dues of one dollar, but the secretary and treasurer shall be exempt from the payment of dues during the years of their service.

(2) Any person who shall have paid thirty dollars in annual dues, or equivalent due to legal exemption, or in one sum, or in any combination, may be elected to life membership, free of assessment, by a two-thirds vote of members present at an annual meeting.

(3) Honorary members may be elected because of special prominence in science upon written recommendation of two members of the Academy, by a two-thirds vote of members present. Honorary members pay no dues.

SEC. 4. The officers of this Academy shall be chosen by ballot at the annual meeting, and shall consist of a president, two vice presidents, a secretary and a treasurer, who shall perform the duties usually pertaining to their respective offices. The president, the secretary and the treasurer shall constitute the executive committee. The secretary shall be in charge of all the books, collections and material property belonging to the Academy.

SEC. 5. Unless otherwise directed by the Academy, the annual meeting shall be held at such time and place as the executive committee shall designate. Other meetings may be called at the discretion of the executive committee.

SEC. 6. This constitution may be altered or amended at any annual meeting by a vote of three-fourths of attending members of at least one year's standing. No question of amendment shall be decided on the day of its presentation.

SEC. 7. This Academy shall have an executive council, consisting of the president, the secretary, the treasurer, the vice presidents, and four other members to be nominated by the nominating committee and elected as the other officers. This council shall have general oversight of the Academy not otherwise given by this constitution to officers or committees.

*As modified by amendments.

BY-LAWS

I. The first hour, or such part thereof as shall be necessary, in each session shall be set aside for the transaction of the business of the Academy. The following order of business shall be observed, so far as practicable:

1. Opening.
2. Reports of officers.
3. Reports of standing committees.
4. Appointment of special committees.
5. Unfinished business.
6. New business.
7. Reports of special committees.
8. Election of officers.
9. Election of members.
10. Program.
11. Adjournment.

II. The president shall deliver a public address on the evening of one of the days of the meeting, at the expiration of his term of office.

III. No meeting shall be held without a notice of the same having been published in the papers of the state at least thirty days previous.

IV. No bill against the Academy shall be paid by the treasurer without an order signed by the president and secretary.

V. Members who shall allow their dues to remain unpaid for two years, having been annually notified of their arrearages by the treasurer, shall have their names stricken from the roll.

VI. The secretary shall have charge of the distribution, sale and exchange of the published Transactions of the Academy, under such restrictions as may be imposed by the executive committee.

VII. Eight members shall constitute a quorum for the transaction of business.

VIII. The time allotted to the presentation of a single paper shall not exceed fifteen minutes.

IX. No paper shall be entitled to a place on the program unless the manuscript, or an abstract of the same, shall have been previously delivered to the secretary.

PAST PRESIDENTS

1869—1870	B. F. Mudge
1871—1873	John Fraser
1874—1878	F. H. Snow
1879—1880	B. F. Mudge
1881—1882	J. T. Lovewell
1883	A. H. Thopmson
1884—1885	E. J. Brown
1886	E. L. Nichols
1887	J. D. Parker
1888	J. R. Mead
1889	T. H. Dinsmore, Jr.
1890	G. H. Failyer
1891	Robert Hay
1892	E. A. Popenoe
1893	E. H. S. Bailey
1894	L. E. Sayre
1895	Warren Knaus
1896	D. S. Kelley
1897	S. W. Williston
1898	D. E. Lantz
1899	E. B. Knerr
1900	A. S. Hitchcock
1901	E. Miller
1902	J. T. Willard
1903	J. C. Cooper
1904	Edward Bartow
1905	L. C. Wooster
1906	F. O. Marvin
1907	J. A. Yates
1908	E. Haworth
1909—1910	F. B. Dains
1911	J. M. McWharf
1912	F. W. Bushong
1913	A. J. Smith
1914	W. A. Harshbarger
1915-16	J. A. G. Shirk
1916-17	J. E. Todd
1917-18	F. U. G. Agrelius
1918-19	L. D. Havenhill
1919-20	R. K. Nabours
1920-21	O. P. Dellinger
1921-22	Roy Rankin
1922-23	R. K. Nabours
1923-24	H. P. Cady
1924-25	H. H. Nininger
1925-26	J. E. Ackert
1926-27	H. J. Harnly
1927-28	Mary T. Harman
1928-29	L. D. Wooster

MEMBERSHIP OF THE ACADEMY

AUGUST 1, 1929

Abbreviations: The following abbreviations for institutions have been used:
K. S. A. C. Kansas State Agricultural College.
K. S. T. C. Kansas State Teachers College.
U. of K. University of Kansas.
Other abbreviations follow those used in the Summarized Proceedings of the American Association for the Advancement of Science.

The year given indicates the time of election to membership

HONORARY MEMBERS

Barber, Marshall A., Ph. D., 1904, U. S. Public Health Service, 118 Court House Bldg., Memphis, Tenn. (Greenwood, Miss.).
Cockerell, T. D. A., D. Sc., 1908, prof. zoology, Univ. Colorado, Boulder, Col.
Franklin, W. S., Sc. D., 1897, prof. physics, Mass. Inst. Tech., Cambridge, Mass.
Franklin, Edward Curtis, Ph. D., 1884, prof. chemistry, Leland Standard Jr. Univ., Cal.
Grimsley, G. P., Ph. D., 1896, geological eng., Baltimore and Ohio R. R., 4405 Underwood Road (Gilford), Baltimore, Md.
Hitchcock, A. S., Sc. D., 1892, principal botanist, U. S. Dept. Agric., Washington, D. C.
Harris, J. Arthur, Ph. D., 1900, head Dept. Botany, Univ. Minnesota, Minneapolis, Minn.
Kellogg, Vernon L., LL. D., Sc. D., 1920, permanent secretary National Research Council, Washington, D. C.
McClung, C. E., Ph. D., 1903, dir. Zoology Lab., Univ. Pennsylvania, Philadelphia, Pa.
McCollum, E. V., Ph. D., Sc. D., 1902, prof. biochemistry, John Hopkins Univ., Baltimore, Md.
Nichols, Edward L., Ph. D., Sc. D., 1885, (honorary member 1897), prof. physics (emeritus) Cornell Univ., Ithica, N. Y.
Riggs, Elmer S., M. A., 1896, assoc. curator paleontology, Field Mus. Nat. Hist., Chicago, Ill.
Wagner, George, M. A., 1894, (honorary member, 1904) assoc. prof. zoology, Univ. Wisconsin, Madison, Wis.

LIFE MEMBERS

Agrelius, Frank U. G., M. A., 1905, assoc. prof. biol., K.S.T.C., Emporia, Kan,
Allen, Herman Camp, Ph. D., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Bailey, E. H. S., Ph. D., 1883, prof. chemistry, U. of K., Lawrence, Kan.
Bartholomew, Elam, Sc. D., 1896, retired, Stockton, Kan.
Bartow, Edward, Ph. D., Sc. D., 1897, prof. and head Dept. of Chemistry, Univ. Iowa, Iowa City, Iowa.
Baumgartner, William J., A. M., 1904, assoc. prof. zoology, U. of K., Lawrence, Kan.
Beede, Joshua W., Ph. D., 1894, prof. geology and paleontology, Indiana Univ., Bloomington, Ind.

Berry, Sister M. Sebastian, A. B., 1911, Supt. Schools, St. Paul, Kan.
Bushnell, Leland D., Ph. D., 1908, prof. and head Bacteriology Dept., K. S. A. C., Manhattan, Kan.
Bushong, F. W., Sc. D., 1896, 2636 Fifth St., Port Arthur, Tex.
Cady, Hamilton P., Ph. D., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Copley, Rev. John T., 1903, Olathe, Kan.
Cragin, F. W., Ph. D., 1880, 912 Migeul St., Colórado Springs, Col.
Crevecoeur, F. F., 1900, Onaga, Kan.
Cook, W. A., M. S., 1907, real estate business, 1414 Highland St., Salina, Kan.
Da'ns, F. B., Ph. D., 1902, prof. chemistry, U. of K., Lawrence, Kan.
Deere, Emil O, M. S., 1905, dean and prof. biology, Bethany Col., Lindsborg, Kan.
Dellinger, Orris P., Ph. D., 1909, prof. biology, K. S. T. C., Pittsburg, Kan.
Dunlevy, R. B., M. A., 1896, Southwestern Col., Winfield, Kan.
Eby, J. Whit, B. S., 1903, banker, Howard, Kan.
Failyer, George H., M. S., 1879, retired, R. R. 4, Manhattan, Kan.
Faragher, Warren Fred, Ph. D., research chemist, Universal Oil Products Co., Riverside, Ill.
Garrett, A. O., M. A., 1901, head Dept. Biology, East High School, Salt Lake City, Utah.
Graham, I. D., M. S., 1879, State Board of Agric., Topeka, Kan.
Harman, Mary T., Ph. D., 1912, prof. zoology, K. S. A. C., Manhattan, Kan.
Harnly, Henry J., Ph. D., 1893, prof. biology, McPherson Col., McPherson, Kan.
Harshbarger, William A., Sc. D., 1903, prof. mathematics, Washburn, Col., Topeka, Kan.
Havenhill, L. D., Ph. C., 1904, dean School Pharmacy, U. of K., Lawrence, Kan.
Haworth, Erasmus, Ph. D., 1882, U. of K., Lawrence, Kan.
Knaus, Warren M., D. Sc., 1882, entomologist, editor "Democrat Opinion", McPherson, Kan.
McWharf, J. M., M. D., 1902, 715 Princeton St., Ottawa, Kan.
Meeker, Grace R., A. B., 1899, city librarian, Ottawa, Kan.
Menninger, C. F., M. D., 1903, 1407 West 10th St., or R. 4, Topeka, Kan.
Miller, Ephraim, Ph. D., 1873, 558 North Lakes Ave., Pasadena, Cal. (Prof. emeritus mathematics and astromy, U. of K.)
Nabours, Robert K., Ph. D., 1910, prof. and head Zoology Dept., K. S. A. C., Manhattan, Kan.
Nissen, A. M., A. B., 1888, farmer, Wetmore, Kan.
Peace, Larry M., 1904, West Ninth St., Lawrence, Kan.
Robertson, W. R. B., Ph. D., 1905, K. S. A. C., Manhattan, Kan.
Reagan, Albert B., Ph. D., 1904, Indian Field Service, Ouray, Utah.
Schaffner, John H., M. S., 1903, research and prof. botany, Ohio State Univ., Columbus, Ohio.
Scheffer, Theodore, M. A., 1903, assoc. biologist, U. S. Biological Survey, Puyallup, Wash.
Shirk, J. A. G., 1904, prof. mathematics, K. S. T. C., Pittsburg, Kan.
Shelley, Edwin Taylor, M. D., 1892, Atchison, Kan.
Smith, Alva J., 1892, consulting eng., 810 Boylston St., Pasadena, Cal.
Smyth, Lumina C. R., Ph. D., 1902, 235 Acton Road, Columbus, Ohio.
Sterling, Charles M., A. B., 1904, assoc. prof. botany and pharmacogonsy, U. of K., Lawrence, Kan.
Sternberg, Charles H., M. A., 1896, 4046 Arizona St., San Diego, Cal.
Welin, John Eric, D. Sc., 1889, prof. chemistry, Bethany Col., Lindsborg, Kan.
Willard, Julius T., D. Sc., 1883, vice-pres. and dean Div. General Science, K.S.A.C., Manhattan, Kan.
Wilson, William B., Sc. D., 1903, head Biology Dept., Ottawa Univ., Ottawa, Kan.
White, E. A., M. A., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Wooster, Lyman C., Ph. D., 1889, prof. biology and geology, K.S.T.C., Emporia, Kan.
Yates, J. A., M. S., 1898, prof. chemistry and physics, K.S.T.C., Pittsburg, Kan.

ANNUAL MEMBERS

Members paid up for 1929 are indicated by an asterisk*. The year given is that of election to membership. If two years are given, the second signifies re-election.

*Ackert, James Edward, Ph. D., 1919, prof. zoology and parasitologist, K. S. A. C., Manhattan, Kan.

Ahlborn, Margaret, M. S., 1928, assoc. prof. food economics and nutrition, K.S.A.C., Manhattan, Kan.

*Albertson, F. W., B. S., 1928, assoc. prof. agric., Hays, Kan.

*Albright, Penrose S., B. S., 1926, asst. prof. physics and chemistry, Southwestern Col., Winfield, Kan.

*Alexander, Jean, B. A., 1929, grad. asst. zoology, K. S. A. C., Manhattan, Kan.

*Allen, Fred W. Jr., M. A., 1927, 748 Osage Ave., Kansas City, Kan.

*Almquist, E. C., A. B , 1929, instr. physics, Hutchinson City Schools, Hutchinson, Kan.

*Ayers, H. D., 1928, Univ. Wichita, Wichita, Kan.

*Baden, M. W. 1929, box 520, Winfield, Kan.

*Baker, H. G., M. A., 1926, assoc. prof. biology, Southwestern Col., Winfield, Kan.

Baker, Lillian, M. A., 1925, prof. clothing and textiles, K.S.A.C., Manhattan, Kan.

Bartlett, Walter E , M. D., 1922, physician, Belle Plaine, Kan.

*Barton, Arthur W., Ph. D., 1928, prof. biology and chemistry, K. S. T. C., Hays, Kan.

*Barnett, R. J., M. S., 1922, prof. horticulture, K. S. A. C., Manhattan, Kan.

*Bennett, Dewey, M. A., 1928, science teacher, High School, Glasco, Kan.

*Bennett, James L., M. A., 1928, prof. physics, Ottawa Univ., Ottawa, Kan.

*Bengsten, Linus, 1924, chemistry, Bethany Col., Lindsborg, Kan.

*Bird, J. S., B. S., 1929, pres. Wheat Farming Co., Hays, Kan.

Blickenstoff, Paul, 1928, 804 14th St., Narna, Idaho.

Boone, George N., 1928, McPherson Col., McPherson, Kan.

*Borman, Ina M., B. S., 1928, supervisor science. K. S T. C., Emporia, Kan.

*Boughton, L. L., B. S., 1929, instr. pharmacy, U. of K., Lawrence, Kan.

*Bowman, J. L., 1928. McPherson Col., McPherson, Kan.

*Bradbury, Dorothy, Ph. D., 1929, 1420 Polk St., Topeka, Kan.

*Branch, Hazel E., Ph. D., 1924, prof. zoology, Wichita Univ., Wichita, Kan.

*Brown, Maud A., 1929, bur. sch. health service, U. of K., Lawrence, Kan.

*Brewster, Ray Q., Ph. D., 1919, prof. chemistry, U. of K., Lawrence, Kan.

*Brinkley, J. R., M. D., 1923, physician, Milford, Kan.

*Britton, Wiley, 1923, 4 Mill St., Kansas City, Mo.

*Brooks, Charles H., B. S., 1928, instr. corres. study, Hays, Kan.

*Brubaker, H. W., Ph. D., 1929, prof. chemistry, K. S. A. C., Manhattan, Kan.

*Brunson, A. M., Ph. D., 1928, assoc. agronomist, U. S. Dept. Agric., K. S, A, C,, Manhattan, Kan.

Bryson, Harry R., M. S., 1928, instr. entomology, K. S. A. C., Manhattan, Kan.

*Burt, Roy A., B. S., 1923, geologist, 738 Board of Trade, Kansas City, Mo.

*Call, L. E., M. S., 1922, dean Div. Agric., director Agric. Exper. Sta., K. S. A . C., Manhattan, Kan.

*Campbell, Marion I., 1929, science teacher, Senior High School, Lyons, Kan.

*Chaney, Margaret, Ph. D., 1928, prof. food economics and nutrition, K. S. A. C., Manhattan, Kan.

*Carpenter, A. C., president Lesh Oil Co., Ottawa, Kan.

*Cave, H. W., M. S., 1929, prof. dairy husbandry, K. S. A. C., Manhattan, Kan.

Challans, Joanna Seiler, A. B., 1928, grad. research asst. zoology, K. S. A. C., Manhattan, Kan.

Clay, G. Harry, B. S., 1926, chemical eng., 420 West 59th St., Kansas City, Mo.

*Cook, G. S., A. B., 1922, Luray, Kan.

*Coonfield, Ben R., M. S., 1927, Austin Teaching Fellow Zoology, Harvard Univ., Cambridge, Mass.

*Cowan, Edwin A., Ph. D., 1929, assoc. prof. psychology, Friends Univ., Wichita, Kan.
*Cowles, Iva F., B. S, 1928, assoc. prof. clothing and textiles, K. S. A. C., Manhattan, Kan.
*Crow, H. Ernest, A. M., 1926, prof. biology, Friends Univ., Wichita, Kan.
*Dalbey, Nora E., 1929, prof. Dept. Botany, K. S. A. C., Manhattan, Kan.
*Davidson, Arthur W., Ph. D., 1927, assoc. prof. chemistry, U. of K., Lawrence, Kan.
*Dean, George A., M. S., 1912, head Dept. Entomology, K. S. A. C., Manhattan, Kan.
*Deland, Maude Sayers, M. D., 1928, physician, State Hospital, Topeka, Kan.
*DePuy, Percy L., M. S., 1929, instr. animal husbandry, K. S. A. C., Manhattan, Kan.
*Doell, J. H., A. B., 1926, prof. biology, Bethel Col., Newton, Kan.
*Douglass, J. R., M. S., 1928, asst. entomologist, U. S. Bureau Entomology, Estancia, N. M.
*Dowd, Dorothea R., M. S., 1928, instr. zoology, K. S. A. C., Manhattan, Kan.
*Duley, F. L., Ph. D., 1929, prof. soils, Agronomy Dept., K. S. A. C., Manhattan, Kan.
*Edgington, Orland, B. S., 1928, science teacher, Almena High School, Almena, Kan.
*Eldridge, Seba, Ph. D., 1928, assoc. prof. sociology, U. of K., Lawrence, Kan.
*Emery, W. T., M. A., 1928, science instr. High School, Wichita, Kan.
*Evans, Neal E., B. S., 1926, instr. Junior High School, Manhattan, Kan.
*Farrell, F. D., B. S., 1924, president, K. S. A. C, Manhattan, Kan.
*Fletcher, Worth A., Ph. D., 1928, assoc. prof. chemistry, Wichita Univ., Wichita, Kan.
*Floyd, E. V., 1929, prof. physics, K. S. A. C., Manhattan, Kan.
Foster, Martha E., M. S., 1925, instr biology, Tulsa High School, Tulsa, Okla.
*Ford, Helen, Ph. D., 1928, head Dept. Child Welfare and Eugenics, K. S. A. C., Manhattan, Kan.
*Friesen, Abraham P., M. A., 1928, prof. physics, Bethel Col., Newton, Kan.
*Garrett, Frank A., B. S., 1929, instr. chemistry and physics, High School, Halstead, Kan.
*Gates, F. C., Ph. D., 1922, prof. botany, K. S. A. C., Manhattan, Kan.
Caranson, Clifford E., B. S., 1927, Dwight, Kan.
*George, P. W., 1929, box 233, Baxter Springs, Kan.
*Gloyd, Howard K., B. S., 1922, instr. zoology, K. S. A. C., Manhattan, Kan.
*Goldsmith, William M., Ph. D., 1924, prof. biology, Southwestern Col., Winfield, Kan.
*Greeder, Herman, D. V. M., 1928, 720 South Roosevelt, Wichita, Kan.
*Green, John D., 1929, head Science Dept., Central Col., McPherson, Kan.
*Gregory, P. W., Sc. D., 1929, prof. zoology, Baker Univ., Baldwin, Kan.
*Grimes, Waldo E., Ph. D., 1925, head Dept. Agric. Economics, K. S. A. C., Manhattan, Kan.
*Gosselin, Charles J., A. B., 1928, Expt. Lab., New Orleans Ref. Co., Sellars, La.
Gordon, W. E., Ph. D., 1928, physics and astronomy, K. S. T. C., Hays, Kan.
*Hafenrichter, A. L., Ph. D., 1928, prof. botany, Baker Univ., Baldwin, Kan.
*Hall, E. Raymond. Ph. D., 1923, 1929, curator mammals Museum Vertebrate Zoology, Univ. California, Berkeley, Cal.
*Hall, J. Lowe, Ph. D., 1929, asst. prof. chemistry, K. S. A. C., Manhattan, Kan.
*Hallstead, A. L., 1929, Hays, Kan.
*Hamilton, J. O., Ph. D., 1919, 1929, prof. physics, K. S. A. C., Manhattan, Kan.
*Harris, C. L., Ph. M., 1928, attorney-at-law, box 1088, Eldorado, Kan.
*Hartman, Hugh E., B. S., 1928, test. eng., 258 North Martinson Ave., Wichita, Kan.
*Henning, C. W., B. S., 1928, science teacher High School, Stillwell, Kan.
*Henry, Edwin R, B. S., 1927, Dept. Psychology, Ohio State Univ., Columbus, Ohio.
*Herrick, Earl H., M. S., 1927, Austin Teaching Fellow, Zoology Dept. Harvard Univ., Cambridge, Mass.

*Hershey, J. Willard, Ph. D., 1920, prof. chemistry, McPherson Col., McPherson, Kan.

*Hertzler, Arthur E., M. D., Ph. D., LL. D., 1928, prof. surgery, Univ. Kansas Medical School, head surgeon Halstead Hosp., Halstead, Kan.

*Hess, Mrs. Katherine, M. S., 1926, asst. prof. clothing and textiles, K. S. A. C., Manhattan, Kansas.

*Hill, Robert T., 1928, B. S., grad. asst. zoology, K. S. A. C., Manhattan, Kan.

*Hoard, Earl L., B. S., 1928, Kingsdown, Kan.

*Hodges, Joseph M, B. S, 1928, technician, Dupray Lab., Hutchinson, Kan.

Holton High School, head Science Dept., 1928, Holton, Kan.

*Horn, Elsa, M. S., 1928, instr. botany, K. S. A. C., Manhattan, Kan.

*Horton, John R., B. S., 1928, assoc. entomologist, U. S. Dept. Agric., 128 South Minn. Ave., Wichita, Kansas.

*Howard, C. W., 1929, Supt. Schools, Holcomb, Kan.

*Hughes, J. S., Ph. D., 1926, 1929, prof. chemistry, K. S. A. C., Manhattan, Kan.

Humphrey, Irwin, M. S., research chemist, Hercules Pwd. Co., Kennel, N. J.

*Hungerford, H. B, Ph. D., 1920, head Dept. Entomology, U. of K., Lawrence, Kan.

*Ibsen, Heman L., Ph. D., 1922, prof. genetics, Animal Husb. Dept., K. S. A. C., Manhattan, Kan.

*Jardine, W. M., Ph. D., 1919, sec. Dept. Agric., Washington, D. C.

*Jelinek, George, 1929, 1020 Houston St., Manhattan, Kan.

*Jewell, Minna E., Ph. D., 1925, asst. prof. zoology, K. S. A. C., Manhattan, Kan.

*Johnson, George E., Ph. D., 1925, assoc. prof. zoology, mammalogist Agric. Exper. Sta., Manhattan, Kan.

Johnson, C. G. Harry, M. A., 1928, asst. prof. chemistry, Colorado Agric. Col., Fort Collins, Col.

*Johnston, C. O., M. S., 1928, asst. plant pathologist, K. S. A. C., Manhattan, Kan.

Jones, William E., B. S., 1928, principal Junior High School, Garden City, Kan.

Jones, F. B, D. V. S., 1928, veterinarian, 517 Leavenworth St, Manhattan, Kan.

*Justin, Margaret M., Ph. D., 1925, 1928, dean Div. Home Economics, K. S. A. C., Manhattan, Kan.

*Kester, F. E., 1929, prof. physics, U. of K., Lawrence, Kan.

King, Herbert H., Ph. D., 1909, prof. and head Chemistry Dept., K. S. A. C., Manhattan, Kan.

*Kitchen, Mary E., B. S., 1924, R. R. 1, box 38A, Larned, Kan.

Kramer, Martha, Ph. D., 1925, food economics and nutrition, K. S. A. C., Manhattan, Kan.

*Lane, H. H., Ph. D., 1929, prof. and head Dept. Zoology, U. of K., Lawrence, Kan.

*Larson, Mary E., A. M., 1925, assoc. prof. zoology, U. of K., Lawrence, Kan.

*Larson, Iva, B. A., 1928, asst. genetics, K S. A. C., Manhattan, Kan.

*Latimer, Homer B., Ph. D., 1928, prof. anatomy, U. of K., Lawrence, Kan.

*Latshaw, W. L., 1923, 1929, assoc. prof. chemistry, K. S. A. C., Manhattan, Kan.

*Lawson, Paul B., Ph. D., 1919, prof. entomology, U. of K., Lawrence, Kan.

*Lehman, Roy P., A. B., 1928, geologist, Sinclair Oil Co, Tulsa, Okla.

*Leist, Claude, M. A., 1929, assoc. prof. biology, K. S. T. C., Pittsburg, Kan.

Lindahl, Glen W., B. S., 1928, supt. schools, Munden, Kan.

*Lindley, E. H., Ph. D., LL. D., 1923, chancellor, U. of K, Lawrence, Kan.

*Lindsdale, Jean M., Ph. D., 1928, research assoc. California Museum Vertebrate Zoology, Univ. California, Berkeley, Cal.

*Long, W. S., 1929, chemistry dept., Kansas Wesleyan, Salina, Kan.

*Lyon, Eric, M. S., 1926, assoc. prof. physics, K. S. A. C., Manhattan, Kan.

*Maus, Pearl M., M. S., 1927, Auburn, Kan.

*Maxwell, Geo. W., M. S., 1929, asst. prof. physics, K. S. A. C., Manhattan, Kan.

*McColloch, J. W., M. S., 1911, prof. entomology, K. S. A. C., Manhattan, Kan.

*McDonald, Clinton C., Ph. D., 1928, prof. botany, Wichita Univ., Wichita, Kan.

*McKinley, Lloyd, Ph. D., 1928, Wichita Univ., Wichita, Kan.

*McMasters, Belle M., B. S., 1928, student, K. S. T. C., 923 Market St., Emporia, Kan.
*Melchers, Leo Edward, M. S., 1918, head Dept. Botany and Plant Pathology, K. S. A. C., Manhattan, Kan.
*Menninger, Karl A., M. D., 1919, physician, Mulvane Bldg., Topeka, Kan.
*Messmore, H. E., E. M., 1929, grad. assist., Chemistry Dept., U. of K., Lawrence, Kan.
*Michner, John M., M. S., 1925 instr. chemistry, Wichita High School, Wichita, Kan.
*Miller, A. W., M. S., 1928, instr. chemistry, Hutchinson Junior Col., Hutchinson, Kan.
*Miller, Edwin Cyrus, Ph. D., 1918, prof. botany, K. S. A. C., Manhattan, Kan.
*Miller, R. F., Ph. D., 1928, prof. physics, Col. Emporia, Emporia, Kan.
*Mohler, R. E., 1929, head Agr. Dept., McPherson Col., McPherson, Kan.
*Moore, Fleming G., Ph. D., 1927, prof. physics, Washburn Col., Topeka, Kan.
Moore, Roy, 1928, rodent control, U. S. Biological Survey, Extension Div., K. S. A. C., Manhattan, Kan.
*Morris, Mary Hope, B. S., 1929, grad. assist. zoology, K. S. A. C., Manhattan, Kan.
*Morrison, Beulah May, Ph. D., 1928, asst. prof. psychology, U. of K., Lawrence, Kan.
*Ninninger, H. H., 1921, McPherson Col., McPherson, Kan.
*Nolf, L. O., B. S., 1928, research asst. zoology, K. S. A. C., Manhattan, Kan.
*Noll, W. C., A. M., 1929, prof. biology, Col. Emporia, Emporia, Kan.
*Oman, A. E., M. F., 1928, asst. biologist, U. S. Biological Survey, Extension Div., K. S. A. C., Manhattan, Kan.
*Painter, Reginald, Ph. D., 1927, asst. prof. entomology, K. S. A. C., Manhattan, Kan.
*Pankratz, David S, M. A., 1928, instr. anatomy, U. of K., Lawrence, Kan.
*Parker, J. H., Ph. D., 1918, prof. crop improvement, Dept. Agronomy, K. S. A. C., Manhattan, Kan.
*Parker, Ralph, L., Ph. D., 1926, 1929, assoc. prof. entomology and apiculture, state apiarist, K. S. A. C., Manhattan, Kan.
*Payne, Nellie M., Ph. D., 1920, scientific staff, Biological Abstracts, Zoological Lab., 38th and Woodlawn Ave., Philadelphia, Pa.
*Perkins, Alfred T., 1925, 1929, asst. prof. chemistry, K. S. A. C., Manhattan, Kan.
*Perrine, Irving, Ph. D., 1921, oil operator, geologist, 1619-21 Petroleum Bldg., Oklahoma City, Okla.
*Peterson, J. C., Ph. D., 1919, prof. education, K. S. A. C., Manhattan, Kan.
*Pittman, Martha S., 1925, M. S., prof. food economics and nutrition, K. S. A. C., Manhattan, Kan.
*Potter, Isabel, M. S., 1926, instr. biology, Winthrop Col., Rock Hill, S. C.
*Prince, S. Fred, 1928, biological artist, K. S. A. C., Manhattan, Kan.
*Rankin, Roy, M. A., 1919, prof. chemistry and bacteriology, K. S. T. C., Hays, Kan.
Readio, Philip A., M. S., 1928, asst. prof. entomology, U. of K., Lawrence, Kan.
*Reinisch, E. F. A., 1917, landscape artist, City Park Dept., City Hall, Topeka, Kan.
*Robinson, W. J., M. S., 1928, prin. High School, Lincoln, Kan.
*Rouse, J. E., M. S., 1928, prof. agric., K. S. T. C., Hays, Kan.
*Royer, W. D., A. B., 1927, instr. biology,, Wichita High School East, Wichita, Kan.
*Rudie, N. H., 1929, science teacher, High School, Hays, Kan.
*Russom, Vaughn, W., A. B., 1928, field geologist, box 543, Wichita, Kan.
*Rust, Mrs. Lucille, M. S., 1928, assoc. prof. education, K. S. A. C., Manhattan, Kan.
*Sager, Howard W., B. S., 1928, supt. High School, Montrose, Kan.
*Salmon, S. C., M. S., 1926, prof. farm crops, K. S. A. C., Manhattan, Kan.
*Sarles, William B., M. S., 1928, instr. bacteriology, K. S. A. C., Manhattan, Kan.
*Sarracino, John, 1928, K. S. T. C., Emporia, Kan., (Valdez, Col.)

*Sayre, Claude E., Ph. D., 1924, clergyman, 448 N. Topeka Ave., Wichita, Kan.
*Schoewe, Walter H., Ph. D., 1925, assoc. prof. geology, U. of K., Lawrence, Kan.
*Schovee, Joseph C., 1928, asst. eng. A. T. & S. F. R. R., 1235 Boswell Ave., Topeka, Kan.
*Schrammel, H. E., Ph. D., 1929, prof. psychology, K. S. T. C., Emporia, Kan.
*Schumann, Margaret, M. A., 1922, technician, Anatomy Dept., U. of K., Lawrence, Kan.
*Seaton, Roy A., M. S., 1928, dean Div. Engineering, K. S. A. C., Manhattan, Kan.
*Setty, Laural R., 1928, Emporia, Kan.
*Sewell, M. C., Ph. D., 1928, assoc. prof. soils, Agronomy Dept., K. S. A. C., Manhattan, Kan.
*Shaad, G. C., 1921, dean Engineering School, U. of K., Lawrence, Kan.
*Shaw, Hurbert deG., Ph. D., 1928, St. Benedicts Col., Atchison, Kan.
*Shaw, Ruth, M. A., 1928, asst. instr. zoology, U. of K., Lawrence, Kan.
*Showalter, Donald F., M. A., 1928, supt. schools, Lebanon, Kan.
*Shuler, Fred E., 1929, student, U. of K., Lawrence, Kan.
Simpkins, Dan, 1928, student, K. S. T. C., Emporia, Kan. (Reading, Kan.)
*Smith, Roger C., Ph. D., 1921, Service Technique, Dept. Agric., Port-au-Prince, Haiti.
Snodgrass, Ethel, M. A., 1928, prof. home economics, K. S. T. C., Hays, Kan.
*Spencer, D. H., 1925, Pharmacy Dept., U. of K., Lawrence, Kan.
*Sperry, Arthur B., B. S., 1917, 1922, prof. geology, K. S. A. C., Manhattan, Kan.
*Stanley, George B., M. D., Ph. D., 1928, physician and surgeon, Windsor Hosp., Windsor, Col.
Steen, Robert A., 1928, student, K. S. T. C., Emporia, Kan. (1702 W. 15th St.)
Stein, Fred W., 1928, president Steinite Radio Co., Atchison, Kan.
*Sternberg, George F., 1928, field vertebrate paleontologist, K. S. T. C., Hays, Kan.
*Stevens, William C., 1890, head Botany Dept., U. of K., Lawrence, Kan.
*Stogsdill, J. W. E., A. B., 1929, East High School, Wichita, Kan.
*Stoland, O. O., Ph. D., 1918, prof. physiology and pharmacology, U. of K., Lawrence, Kan.
*Stoltz, Martha, M. S., 1928, prof. biology, Ottawa Univ., Ottawa, Kan.
*Stone, J. R., 1923, 1929, Quartermaster's Office, U. S. Disciplinary Barracks, Ft. Leavenworth, Kan.
*Stouffer, E. B., Ph. D., 1929, dean Grad. School, U. of K., Lawrence, Kan.
*Studt, Charles W., M. S., 1928, chief geologist, Union Gas Co., Independence, Kan.
*Sumpter, Helen, 1929, box 354, Hillsboro, Kan.
*Sutter, L. A., M. D., 1923, physician, 601 First National Bank Bldg., Wichita, Kan.
*Swanson, Arthur F., M. S., 1926, agronomist, Fort Hays Exper. Sta., Hays, Kan.
*Taft, Robert, Ph. D., 1923, assoc. prof. chemistry, U. of K., Lawrence, Kan.
*Taylor, Edward H., Ph. D., 1928, assoc. prof. zoology, U. of K., Lawrence. Kan.
*Thompson, D. Ruth, M. A., 1928, prof. chemistry. Sterling Col., Sterling, Kan.
*Tissue, Kathryn Anne, M. S., 1929, head Dept. Home Economics, Ottawa, Univ., Ottawa, Kan.
*Treece, E. Lee, Ph. D., 1929, assoc. prof. bacteriology, U. of K., Lawrence, Kan.
*Truesdell, B. W., B. S., 1923, head Science Dept. High School, (706 N. Lawrence Ave.) Wichita, Kan.
Tucker, Ruth E., M. S., 1928, inst. food economics and nutrition, K. S. A. C., Manhattan, Kan.
*Wade, Joseph S., 1927, assoc. entomologist, U. S. Dept. Agric, Washington, D. C.
Walkden, Herbert, 1928, 126 S. Minnesota Ave., Wichita, Kan.
*Walker, M. V., 1929, biology science instr., Plainville, Kan.
*Walters, Orville, 1928, Enid H. S., Enid, Okla.
*Wampler, R. W., 1929, M. S., asst. prof. chemistry, K. S. A. C., Manhattan, Kan.
Warren, Don C., Ph. D., 1925, assoc. prof. poultry husbandry, K. S. A. C., Manhattan, Kan.
*Watson, G. N., Ph. C., B. S., manager, Watson Lab., Independence, Kan.
*Weatherly, Mrs. J., 1929, A. M., prof. psychology, K. S. T. C., Hays, Kan.

*Weber, Clement, Catholic priest, Clay Center, Kan.
*Weber, Louis R., 1929, A. M., head Physics Dept., Friends Univ., Wichita, Kan.
*Wedel, D. J., 1925 A. M., chemistry, Bethel Col., Newton, Kan.
*Weeks, Elvira, Ph. D., 1927, asst. prof. chemistry, U. of K., Lawrence, Kan.
*Weidlein, Edward Ray, Sc. D., 1921, director Mellon Inst. Industrial Research, Pittsburgh, Pa.
*Weidlein, W. D., B. S., 1928, prof. physics, Hays, Kan.
*Wells, J. R., 1920, 1929, K. S. T. C., Pittsburg, Kan.
*Whitcomb, S. L., A. M., Hon. Litt. D., 1926, prof. English, U. of K., Lawrence, Kan.
*Wimmer, Edward J., Ph. D., 1928, asst. prof. zoology, K. S. A. C., Manhattan, Kan.
*Wood, E. R., Ph. D., 1929, Dir. Bur. Educational Meas. and Standards, K. S. T. C., Emporia, Kan.
*Wooster, L. D., Ph. M., 1924, prof. biological sciences, K. S. T. C., Hays, Kan.
Worden, Alice R., 1928, student, K. S. T. C., Emporia, Kan., (906 N. Jefferson St., Wellington, Kan.)
*Wunsch, W. A., B. S., 1927, county extension agent, Carlsbad, N. M.
*Yoder, J. J., LL. D., 1926, prof. sociology, McPherson Col., McPherson, Kan.

SIXTY-FIRST ANNUAL MEETING

KANSAS ACADEMY OF SCIENCE

Kansas State Agricultural College

Manhattan, April 25-27, 1929

OFFICERS FOR 1928-1929

L. D. Wooster, Hays ---------------------------------- President
W. B. Wilson, Ottawa ------------------------ First Vice-President
Hazel E. Branch, Wichita ----------------- Second Vice-President
L. D. Havenhill, Lawrence ----------------------------- Treasurer
G. E. Johnson, Manhattan ------------------------------ Secretary
Mary T. Harman, E. O. Deere, F. C. Gates, and E. A. White.
Additional Members of the Executive Council

PROGRAM

Thursday, April 25, Denison Hall, Room C26

8:15 p. m. Lecture: "Chemical Warfare", Major Haig Shekerjian, Fort Leavenworth. (Under joint auspices of the Academy and the Kansas State Chapter of the American Chemical Society at Manhattan, Kansas.)

9:20 p. m. Meeting of the Executive Council of the Academy.

Friday, April 26, Denison Hall, Room C26

8:30 a. m. Announcements and Business.

8:45 a. m. General Papers, C26.
Chemistry and Physics Papers, C27.

12:15 p. m. Luncheon at College Cafeteria. Short address: "The Relation of Nutrition to Reproduction". Dr. Herbert M. Evans, University of California.

1:45 p. m. General Papers.

3:30 p. m. Lecture: "The Function of the Anterior Hypophysis". Dr. Herbert M. Evans, University of California. (Under joint auspices of the Academy, Science Club, Gamma Sigma Delta, Veterinary Division, Alpha Zeta, and Omicron Nu at the Kansas State Agricultural College.)

6:15 p.m. Banquet at College Cafeteria.

8:00 p.m. Presidential Address:

"Certain Aspects of Research" ------------ L. D. Wooster

Motion Pictures:

1 Observations of the Nine-banded Armadillo.
H. H. Nininger

2 Cinematographs of Living Developing Rabbit Eggs.
P. W. Gregory

Saturday, April 27

General Session, Denison Hall, C26

8:15 a.m. General Papers.

10:00 a.m. Business and Election of Officers.

12:00 m. Adjournment of General Session.
Meeting of New Executive Council.

Entomology Meeting
Kansas Entomological Society

9:00 a.m. Business, Fairchild Hall, Room 53.

10:00 a.m. Academy Business Meeting. Denison Hall, C26.

1:30 p.m. Papers. Fairchild Hall, Room 53.

Psychology Meeting

8:00 a.m. Papers and Business. Education Hall, Room 54.

10:00 a.m. Academy Business Meeting. Denison Hall, C26.

PAPERS SUBMITTED FOR THE SIXTY-FIRST MEETING

GENERAL PROGRAM

1 Synthetic Diamonds. -- J. Willard Hershey
2 Interlocking Table for Use in Multiple Correlation. -------------- E. R. Wood
3 The Effect of Long-Continued Soaking on Seed Germination.
Arthur Willis Barton
4 Rennin Standardization and Deterioration. --------------------- L. D. Haverhill
5 A Preliminary Report on a Study of Siamese Calculi. ------------ L. L. Boughton
6 Anatomical Character of the Genus Lonicera. ---------- Marshall W. Mayberry
7 Brown-Rot Leaf and Twig Blight following Peach Leaf Curl. ------ A. J. Mix
8 A Blight of Flowering Almond, Prunus glandulosa Thunb. ------------ A. J. Mix
9 Economic Affiliations of the Kansas Flora. ------------------------ W. C. Stevens
10 Notes on the Comparative Anatomy of Allied Species of Plants. W. C. Stevens
11 Comparative Anatomy within the Genus Celastrus. ------------ Helen Sumpter
12 The Effect of the Injection of Anterior Pituitary Extract on Albino Mice.
Robert T. Hill
13 The Effect of Alfalfa on Soil Moisture. -------------------------------- F. L. Duley
14 Some Factors Affecting the Amount and Nature of Flora in Central Kansas.
W. J. Robinson
15 Cannibalism and Food Scarcity in Bass and Crappie. ------ Edward Schneberger
(Introduced by Minna E. Jewell.)

16 An Old World Cestode Found in American Fishes. .... Claude Leist
17 The Histology of Animal Pigmentation. 1. Early Pigmentation of the Chick Retina .... William M. Goldsmith
18 A Flora of Wabaunsee County Based on Collections During 1926 and 1927. Pearl M. Maus
19 An Unusual Head of Sorghum (Blackhull Kafir) with Greatly Proliferated Spikelets. .... H. H. Laude and F. C. Gates
20 Botanical Notes, 1928. .... F. C. Gates
21 Studies on the Breeding Habits and Young of the Copperhead, Agkistrodon mokasen Beauvois. .... H. K. Gloyd
22 The Reptilian and Amphibian Life of a Kansas Swamp. .... H. K. Gloyd
23 Obtaining and Controling Illumination Levels. .... O. D. Hunt (Introduced by J. C. Peterson.)
24 The Work Curve as Affected by Variations in Illumination. ..... J. C. Peterson
25 Expedition to Catarina, Baja, California, Mexico. .... Charles H. Sternberg
26 An Animal Experiment for Diet Comparisons Showing the Value of Data in Addition to Growth Records. .... Isabelle Gillum and Edith E. Martin
27 Some Observations of the Effect of the Addition of Iron to an Adequate Diet. ...... Myra T. Potter
28 Vitamin A Content of the Green and White Leaves of Market Head Lettuce. Ruth Esther Williams, Gladys Boehm and Martha M. Kramer
29 A Method for Comparing the Economy of Various Foods as Sources of Dietary Essentials. .... Adelaide Glaser and Martha M. Kramer
30 A Comparison of the Protective Value of Certain Fabrics in Still and Moving Air. ... . Katherine Hess, Lillian Baker and E. V. Floyd
31 A Suggested Revision of the Terminology of Agriculture.........L C Wooster
32 Laboratory Apparatus—The Ecostat. .. A. L. Hafenrichter and G. W. Goldsmith
33 The Growth and Metabolism of Wild Yeasts. Pauline D. Lidikay and Thomas I. Edwards (Introduced by A. L. Hafenrichter.
34 Epidemiology of Pullorum Disease. .... L. D. Bushnell
35 The Twins of the Hoerner Family. .... H. J. Harnly
36 Some New Mutations in Guinea-Pigs. .... H. L. Ibsen
37 Certain Aspects of Hay Fever. .... Elsa Horn
38 Notes on the Oxidation of Certain Meteorites. The Formation of Meteorodes. H. H. Nininger
39 The Present Status of the Whooping Crane. .... H. H. Nininger
40 The Embryological Basis for Size Inheritance in the Rabbit. .... P. W. Gregory
41 Protection of Seed Corn Against Moles. .... George E. Johnson
42 Somatic Cell Mutation. .... H. G. Baker
43 The Iodine Content of the Waters of Kansas. .... H. W. Brubaker
44 The Importance of Vitamin A in an Adequate Diet. .... J. S. Hughes
45 The Resistance of Chickens to Parasites and Vitamin B. .... L. O Nolf
46 A Study of the Effect of Thymectomy upon the Growth and Development of Chickens. .... Mary Hope Morris
47 Effect of Anthelmintic on Host Animals. .... G. L. Graham
48 The Intrusive Rocks of Riley County. .... A. B. Sperry
49 Aegilops cylindrica as a Wheat Field Weed. .. C. O. Johnston and J. H. Parker
50 Flora of Ellsworth County, Kansas. .... Clement Weber
51 Geology of the Deep Creek Reservation (Utah) and Environs. Albert B. Reagan
52 Medicinal Plant Cultivation. .... Fred Shuler

CHEMISTRY-PHYSICS MEETING

1. Physiological Effects of Oxygen Atmospheres Diluted by Nitrogen. J. Willard Hershey
2 The Preparation and Reactions of Certain Formamidines. F. B. Dains and Sister Agnes Ellen Daily
3 The Synthesis of Thiazolidones. .... F. B. Dains and John F. Schwab
4 A Study of Nitrogen Requirements of Some Bacteria. Lee Treece and Ray Brewster
5 Studies in Autolysis. Autolysis in Seeds. .... Arthur Willis Barton
6 The Effect of Sodium-Calcium Balance on Nerve Excitability....J. Lowe Hall
7 The Measurement of Annual Variation of the Antirachitic Properties of the Sunshine in Kansas. .... R. L. Pycha and J. S. Hughes
8 Exchangeable Iron in Soils. .... A. T. Perkins
9 The Electro-Deposition of Lead from Liquid Ammonia Solutions. Robert Taft and Harold Barham
10 The Influence of Gelatin on the Form of Electro-Deposited Copper. Robert Taft and H. E. Messmore
11 Gels of Cellulose Acetate in Liquid Ammonia. Robert Taft and Jesse Stareck
12 The Formation of Lead Crystals in Silicia Gels. Robert Taft and Jesse Stareck
13 Preliminary Studies in Ternary System: Cupric Acetate-Ammonium Acetate-Acetic Acid. .... Ernest Griswold and Arthur W. Davidson
14 Some Properties of Aluminum Anodes. .... A P Friesen
15 Ammono-gels of Silicic Acid. .... B. L. Smits

16 Fluorescense of Protiens in Ultra-Violet Light. E. L. Tague
17 Methods of Determining Activity Coefficient of Dissolved Substances. R. W. Wampler
18 Solvents for Gum Arabic. Robert Taft and Lloyd Malm
19 The Determination of Silica in Clays. Harold E. Messmore
20 The Reduction of Organic Compounds with Liquid Hydrogen Iodide. Ray Brewster and Albert Schmidl
21 Orientation of Molecules. H. H King
22 The Use of Chemicals in Control of Weeds. W. L. Latshaw
23 Some Absorbtion Spectra. J. O. Hamilton
24 A Method of Rating Dissonance. E. V. Floyd
25 Use of Doppler's and Bradley's Principles in a Wave Mechanics Interpretation of Electrostatic and Magnetic Forces. Eric R. Lyon
26 Air Temperature Around a Heated Wire. Homer P. Smith and C. V. Kent
27 Acoustics of University of Kansas Auditorium. Ralph R. Stevens
28 A Study of Adsorption of Gases on a Surface of Mercury. H. H. King and J. Lowe Hall

ENTOMOLOGY MEETING

The Fifth Annual Meeting of the Kansas Entomological Society

1 Scolops osborni Ball in Kansas. R. H. Beamer
2 Some Leaf Hopper Problems. P. B. Lawson
3 The Sarcophagidae of Kansas. David G. Hall
4 Some Observations of Triphleps insidiosis Say. G. E. Marshal
5. The Genus Agrilus of Kansas. Warren Knaus
6 Here and There in European Museums in Quest of Types. (Illustrated) H. B. Hungerford

PSYCHOLOGY MEETING

1 Psychological Offerings of the Colleges of Kansas. H. E. Schrammel
2 Apparatus for the Study of Visual Illusions. R. C. Langford
3 Prediction of Success in College by Means of Mental Tests and Cumulative Scholastic Records. Ralph A. Irwin
4 The Types of Children in Our Schools. Josephine Weatherly
5 Comparative Results of Three Tests of Intelligence. D. F. Showalter
6 Prediction of Success in High School by Means of Mental Tests and Cumulative Scholastic Records. C. W. Howard
7 Children's Efforts at Problems Solving. P. P. Brainard
8 Acquisition of Left Handedness. C. E. Lauterbach

MINUTES OF THE SIXTY-FIRST ANNUAL MEETING

The sixty-first annual meeting of the Kansas Academy of Science was held at Manhattan, April 25, 26 and 27, 1929. The program was carried out completely as printed, with the exception of changes in the order of papers and the reading by title of nine on the general program and seven on the Chemistry-Physics program.

A short business meeting was called to order by President Wooster at 8:40 a. m. Friday. The minutes of the last annual meeting were read and approved. By motion papers were limited to ten minutes.

The following committees were appointed:

Program: Gates, Agrelius, with Hughes and Ackert for certain parts of the program.

Resolutions: Nininger, Deere.

Auditing: Wilson, Barton.

Membership: Johnson, Rankin, Havenhill, Agrelius, Hershey, Deere.

Nominating: Nabours, Rankin, Agrelius, Harnly.

Necrology: Willard, Knaus.

The main business meeting was held on Saturday and was called to order by President Wooster at 10:30 a. m. The report of the secretary was read and approved. A rising vote of thanks was given the secretary for his work.

The treasurer reported a balance of $197.91 in the treasury, with a payment of $500.00 still to be received from the University of Kansas Library. The auditing committee reported the accounts to be correct.

The publication committee recommended that the Academy pubishlish Volume 32 of the Transactions according to plans formulated by the new publication committee, providing that the cost be chiefly covered by the sale of volumes and reprints. The recommendation was approved.

Dr. Gates reported on the relationship of the Academy to the American Association for the Advancement of Science. Two points brought out were the encouragement by the Academy of younger members and a longer tenure of office of the representative of the Academy to the American Association.

By motion the secretary was made the official representative to the American Association for the Advancement of Science for the next meeting, the executive council to appoint a substitute if the secretary cannot attend.

The committee on resolutions presented the following resolutions:

1. That we express our appreciation to President Farrell and the members of the faculty of the Kansas State Agricultural College for the hospitality extended the Kansas Academy of Science during its sixty-first annual meeting.

2. That we express our appreciation to the officers of the Academy and to the Kansas State Chapter of the American Chemical Society, the Science Club, Gamma Sigma Delta, the Veterinary division, Omicron Nu and Alpha Zeta, all of the Kansas State Agricultural College, for the securing of outstanding speakers for the meeting.

3. That we express our thanks to Dr. Herbert M. Evans of the University of California for his highly enjoyable and masterly addresses upon his notable scientific researches, and to Major Haig Shekerjian for his valuable contribution to the program at the opening of the session.

4. That we feel deeply grateful to our secretary, Dr. G. E. Johnson, and to the other members of the Committee on Publications for their tireless efforts and

successful results in bringing up to date the Transactions of the Academy in the neatly bound Volume 31, covering the fifty-fourth to the sixtieth meetings inclusive.

5. That we rejoice in the growth of the Academy and in the activity of its membership as evidenced by the large number of papers offered for the program. We join our president in the sentiments he voiced that the growth of the Academy should not result in a loss of that unity which has so long characterized the various departments of science in the state of Kansas.

Dr. Nabours moved that the resolutions be amended so as to include thanks to Prof. H. H. Nininger and Dr. P. W. Gregory for their motion pictures. The amendment was carried. The resolutions were then approved.

The secretary was instructed by motion to communicate the disapproval of the Academy of a proposed added tariff on microscopes and other scientific instruments to our congressmen.

Upon motion the following were elected life members of the Academy: Orris P. Dellinger, Robert K. Nabours, William B. Wilson, Sister M. Sebastian Berry, Leland D. Bushnell.

The following amendment to the constitution, which had been read the previous afternoon, was read the second time and adopted:

SECTION 3. The membership of this Academy shall consist of three classes: annual, life and honorary.

(1)) Annual members may be elected at any time by the committee on membership, which shall consist of the secretary and other members appointed annually by the president. Annual members shall pay annual dues of one dollar, but the secretary and treasurer shall be exempt from payment of dues during the years of their service.

(2) Any person who shall have paid thirty dollars in annual dues, or equivalent due to legal exemption, or in one sum, or in any combination, may be elected to life membership, free of assessment, by a two-thirds vote of members present at an annual meeting.

(3) Honorary members may be elected because of special prominence in science, upon written recommendation of two members of the Academy, by a two-thirds vote of members present. Honorary members pay no dues.

The question of disposal of the Academy library was brought up by Nininger. It was suggested by Nabours that such a disposal would have to be made by agreement with the library of the University of Kansas. Gates suggested that the University could have first chance to purchase the library. By motion it was recommended to the publication committee that the whole question of the library be taken up and a report made to the Academy next year as to what can be done.

The Psychology group of the Academy, through their chairman, Dr. Peterson, reported the desire to form a section of the Academy. By motion the holding of a separate program of psychology papers was to be encouraged for next year.

The Kansas Entomological Society, through its secretary, R. L. Parker, requested representation on the Academy Council. Action on this was postponed till another meeting.

The Chemistry-Physics group which had held a successful program this year, reported through their chairman, Dean Havenhill, that they wished to try holding a separate program again next year without

forming a section, with the idea that if present interest kept up that they would form a section later.

The nominating committee recommended the following for officers for 1929-1930: president, W. B. Wilson; first vice-president, Hazel E. Branch; second vice-president, Wm. M. Goldsmith; treasurer, Ray Q. Brewster; secretary, G. E. Johnson; additional members of the executive council, L. D. Wooster, J. Willard Hershey, E. R. Wood and L. D. Havenhill. Nominations from the floor were called for. President L. D. Wooster requested withdrawal of his name as he will be out of the state next year. This was accepted and the name of R. L. Parker of the Kansas Entomological Society substituted upon motion by Ackert. The nominees were then elected.

Dr. Wilson invited the Academy to meet at Ottawa and Professor Rankin extended a like invitation from Hays. By vote of 21 to 19 it was decided to meet at Hays.

At 12 m. it was voted that thirty minutes be given to the reading of the papers still on the program.

After the reading of the papers, the new publication committee was announced by the incoming president as follows: G. E. Johnson, F. C. Gates, Roy Rankin, W. J. Baumgartner, Martha Stoltz. The meeting adjourned at 12:30 p. m.

GEORGE E. JOHNSON, Secretary.

Report of the Secretary

1. **Publication** After the State Printing Commission at Topeka had informed the Academy that it would be illegal for the state to publish the Transactions of the Academy, bids were secured from three printing companies in Manhattan and from one outside firm on the printing of Volume 31 of the Transactions of the Academy. Upon vote of the publication committee the work of printing 500 copies of this volume was given to the Kimball Printing Company of Manhattan, at $2.00 per page, with 200 reprints of each paper to be provided at $0.50 a page, cuts and tables charged extra. Members were then notified as to the cost of publication and informed that the Academy would pay $1.00 a page up to $10.00 for any one author. Upon this basis the papers published in Volume 31 were accepted and turned over to the Kimball Printing Company as fast as they were received and edited.

2. **Arrangment with the University of Kansas Library.** With Volume 31 under way and financed, attention was turned to providing for future publication. Letters were sent to President Farrell of the Kansas State Agricultural College and to Chancellor Lindley of the University of Kansas on June 7, 1928, informing them of the

policy adopted at the sixtieth annual meeting regarding elimination of free exchange (Transactions, 31:45-46), and suggesting the purchase of copies of the Transactions for the purpose of library exchange with other academies and societies. President Farrell expressed interest, but would take no action unless the University did not wish to take up the matter. Chancellor Lindley inquired as to cost and as to protection of an exchange list if they purchased 500 copies of each volume. The secretary's letter and the Chancellor's reply follow:

July 2, 1928.

Chancellor E. H. Lindley,
University of Kansas,
Lawrence, Kansas.
Dear Chancellor Lindley:

I was glad to have your letter and to answer the questions in regard to the Transactions of the Kansas Academy of Science. While I would have to submit any proposition in regard to purchase of the Transactions to the other members of the Publication Committee, I think I can outline arrangements which would in the main be satisfactory to them.

If 500 or more volumes were bought annually from the Academy, I feel confident that the Academy would be willing to give exclusive exchange rights to the institution making the purchase. Exchanges made after this arrangement is put into effect will, of course, belong to the institution making the purchase of the Transactions and doing the exchanging, but the Academy would not by virtue of such sale give up ownership in the Academy library which has already been accumulated. The Academy would no longer make exchanges with other Academies or societies.

As to cost, the bids received this year show that the Academy would need to receive $3.00 a page for 500 copies of an edition. I would estimate that we should print from 150 to 200 pages or possibly more a year, which would bring the cost to about $450 or $600 a year for 500 copies. I believe that if we were paid $500 a year for 500 copies of between 150 and 200 pages that we could finance the remainder if this did not cover the cost. If the edition should contain less than 150 pages we could accept payment at $3.00 a page. If you favor the idea we might limit the edition for 1928 and for 1929 to 200 pages each so that the payment by the University would not be over $500 for each of these years, with the understanding that at the end of this two year period the Academy and the University may take up the matter of providing more funds for a larger edition than 200 pages whenever this seems desirable. I believe that some reasonable adjustment could be reached when the need for a larger volume became apparent. One cannot predict with any certainty what will happen in the future in regard to number of papers presented for publication, but the Academy is very determined to publish regularly from this year on, and with regular publication I believe there will be an over-supply of papers rather than a scarcity of them for the suggested volume of 150 to 200 pages, so some arrangement for expansion would be desirable.

I shall be glad to give any other information that I can. Upon hearing from you as to your decision in the matter I will communi-

cate with other members of the publication committee and should be in a position to give you the action of this committee promptly.

Sincerely yours,
GEORGE E. JOHNSON,
Secretary and Member Publication Committee.

University of Kansas
Lawrence, Kansas,
July 20, 1928.

Dr. George E. Johnson, Secretary,
Kansas Academy of Science,
Manhattan, Kansas.
My Dear Dr. Johnson:

On my arrival home from a somewhat extended absence I find the correspondence covering the proposal of the Kansas Academy of Science. I concur in the recommendation of Professor Flint, of the Publication Committee, Mr. E. N. Manchester, Librarian, and Dean E. B. Stouffer, of the Graduate School, that the University of Kansas agree to buy five hundred copies of each volume of the Kansas Academy of Science under the following conditions:

1. That the University pay not more than three dollars per page per volume up to a maximum of $500.00 per year.

2. That the University have the exclusive right of exchange for the publications of the Kansas Academy of Science.

3. That this agreement be entered into for a period of two years with the option of continuance.

Please advise me if this is satisfactory,

Very sincerely yours,
E. H. LINDLEY,
Chancellor.

After this agreement with the University was approved by the publication committee and also by the executive council, 300 more copies of the Transactions were ordered printed at a rate of $0.25 a page per hundred copies. No reduction in charge against the authors was made on account of the sale to the University and no increase was charged them on account of the 300 extra volumes ordered by the Academy. The Kimball Printing Company delivered 820 copies of Volume 31, of which 500 were sent to the University Library, about 250 to members, and approximately 70 are on hand.

Membership. At the close of the 60th annual meeting the Academy had a list of 222 annual, 50 life, and 12 honorary members. In preparing the membership list for Vol. 31 of the Transactions the dues of the annual members were checked for the seven years to be covered by the new volume. Omitting the 18 new members in 1928, it was found that only seven of the 204 annual members had no arrears for any portion of their membership coming within the seven year period. Bills were sent out ranging from $1.00 to $2.50, or even to $7.00 for those who were not national members. Many members

responded by paying dues in full and checks for $3.00 to $5.00 were sometimes received . As a result of these bills and of new ones sent out in June, 1928, and still others sent out early in 1929 the paid up membership for the year 1928 was brought up from seven to 93, omitting all new members in 1928. The total new membership for 1928 was increased from 18 to 94, making a total paid up membership of 187 for the year 1928, The names of these 187 persons were starred in the new volume, except that W. J. Robinson, Arthur W. Barton, W. T. Emery, D. F. Showalter and Hubert deG. Shaw, joined too late to have their names included. As all the other new members for 1928 are already listed in the Transactions it would seem unnecessary to read their names here now.

Up to the present time 49 persons have come into the Academy as new members in 1929. Some of these are former members who had temporarily lost interest because of lack of publication by the Academy. Many are members of the American Association for the Advancement of Science to whom three or more communications have been sent during the past twelve months. Many of the new members for both 1928 and 1929 have been secured by members of the membership committee and by some other members of the Academy. The new members for 1929 will be included in the published membership list.

Interest. A gratifying interest has been shown by both old and new members . The loss of members has been chiefly due to change of residence to other states to some extent of teachers and to a greater extent of graduate students. The organization has already benefitted from the large influx of new members, and from the limitation of membership to those who are interested enough to pay dues. It is apparent that a large proportion of scientific workers in Kansas believe in the Academy of Science, and while it may not be quite the influence it once was before the numerous scientific journals of national scope were founded it seems that it should fill an important place in scientific work and progress in the state of Kansas as an avenue of publication, as an organization stimulating research through its annual program of papers, and as a means of promotion of fellowship among the many scientists of the state.

GEORGE E. JOHNSON, Secretary.

Treasurer's Report

April 25, 1929

Balance brought forward		$183.46
Receipts:		
Dues	$401.50	
Allowance from A.A.A.S. 1928-1929	121.00	
From authors for publication and reprints	549.18	
Interest on deposits	10.66	
New received for the year	$1,082.34	1,082.34
Total receipts		$1,265.80
Expenses:		
Secretary White at Wichita		18.00
Stenographic		1.25
Secretary, office expense, postage, assistance, etc.		108.39
Cuts for Transactions		106.25
Printing of Transactions		834.00
Total expense for year		$1,067.89
Balance on hand		$197.91

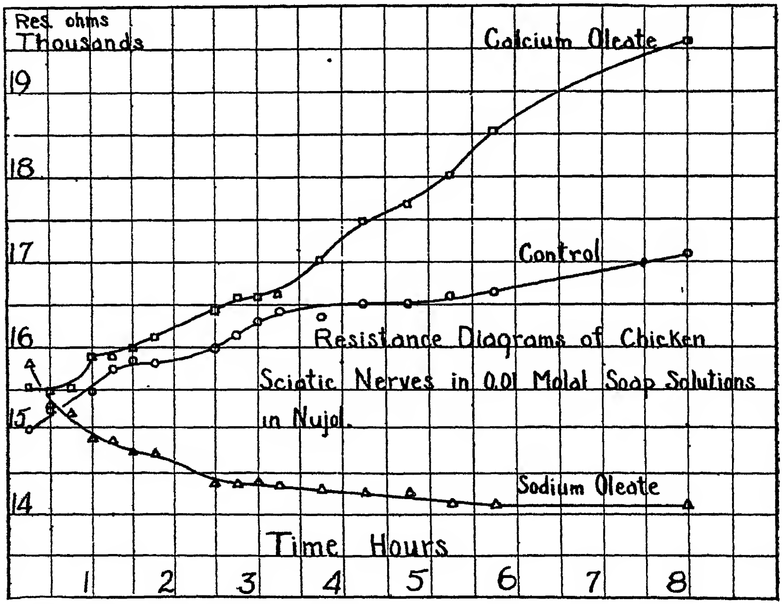
L. D. HAVENHILL, Treasurer.

PAPERS AND ABSTRACTS
Sixty-first Annual Meeting, Manhattan, 1929

THE SODIUM-CALCIUM BALANCE AS A FUNCTION OF NERVE EXCITABILITY AND CELL PERMEABILITY (Abstract)

J. LOWE HALL
Kansas State Agricultural College, Manhattan, Kansas

Many cases have been recently cited to show that calcium deficiency is accompanied by nervous hyperexcitability which may extend to tetany. In continuation of the sodium-calcium-reversible two-phase system theory for nervous tissue proposed by Hughes and King (Science, 57: 590-91, 1923) it has been shown experimentally that nervous excitability as measured by electrical conductivity of chicken nerve shows a marked decrease when the nerve is immersed in a nujol solution of calcium oleate. In a nujol solution of sodium oleate the conductivity shows a marked increase.



The lipins, particularly lecithin, in the cell wall probably form soap-like compounds with sodium and calcium ions. The calcium soap, not being wetted by water, prevents the capillary penetration of the aqueous phase through the inter-cellular spaces. The tissue thus becomes essentially "oil-continuous" and a poor conductor. The sodium soap, being wetted by water, permits capillary penetration of the aqueous phase, and the tissue becomes a good conductor. This assumtion was substantiated by showing that capillary rise between glass plates coated with cholesterol containing a trace of lecithin occurred at a much greater rate with sodium chloride in aqueous solution than with calcium chloride.

A METHOD FOR COMPARING THE RELATIVE ECONOMY OF VARIOUS FOODS AS SOURCES OF DIETARY ESSENTIALS

ADELAIDE L. GLASER AND MARTHA M. KRAMER

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Kansas State Agricultural College, Manhattan, Kansas

The importance of mineral constituents in the diet is now generally recognized and particular attention is being given to those thought to be most frequently low in the American diet. Iron is one of these

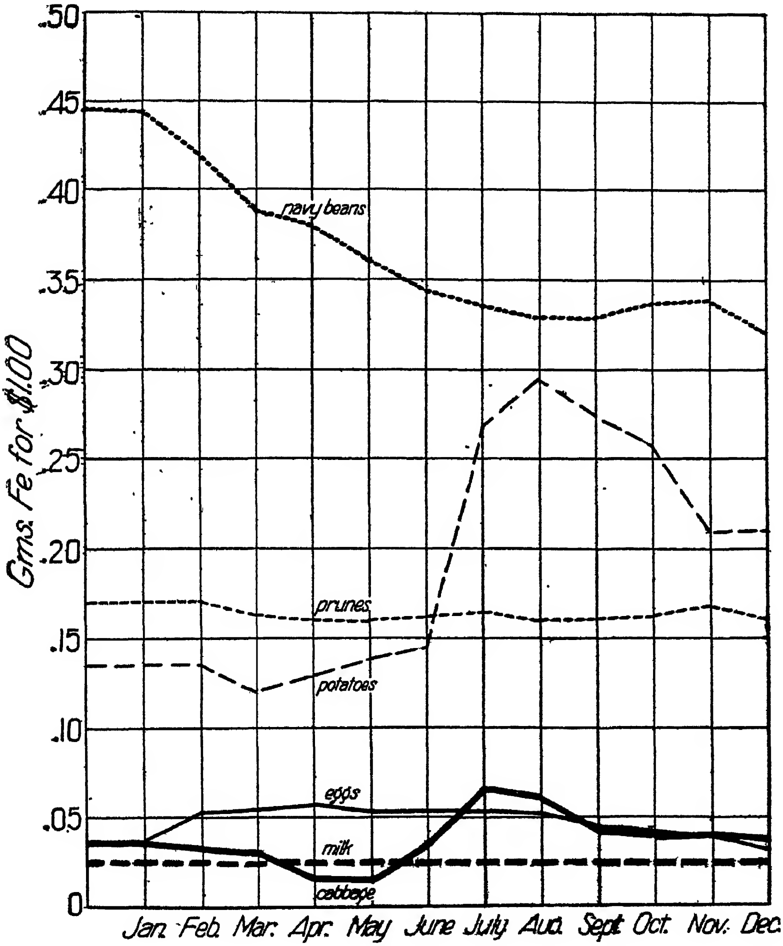

CHART I. Variations in the amount of iron received for $1.00 spent for food in Kansas City, Mo., in 1928.

last. Recently it has been found that glandular organs which are commonly inexpensive, are rich sources of iron and are also excellent in aiding in blood regeneration. On the other hand, many foods which are good iron sources are high in price. It, therefore, seemed of interest to find a method for comparing the economy of various foods as sources of dietary essentials, the method to be first used for iron. A comparison of meat products with other foods seemed of particular interest.

For the comparison it was necessary to secure data on the percentage of iron in foods and also figures on the current prices of foods. For this study only the more recent data on iron analyses were used. In 1927, Elvehjem and Peterson (1), of the University of

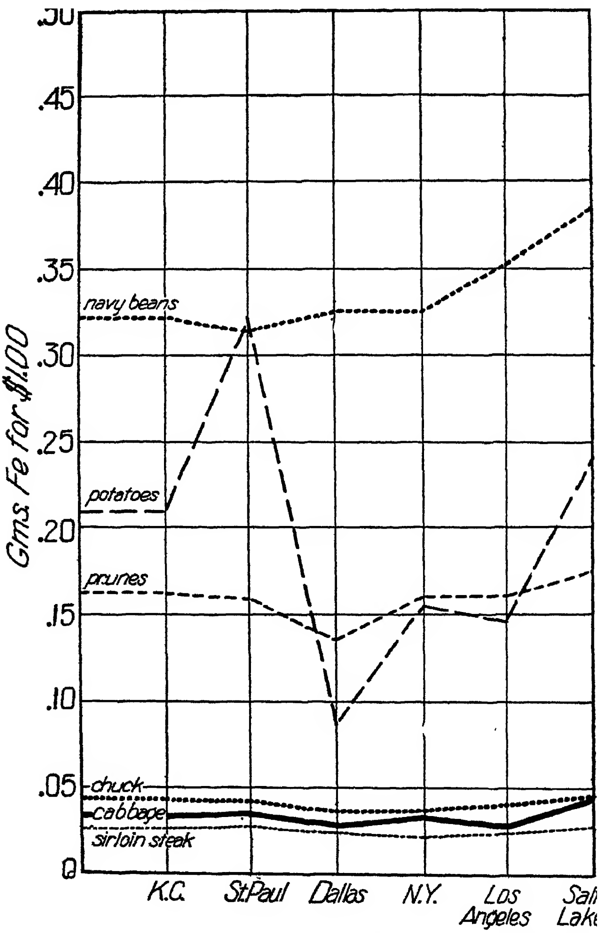

CHART II. Variations in the amount of iron received for $1.00 spent for foods in different regions of the United States in December, 1928.

Wisconsin, analysed about 150 common foods for iron content. Forbes and Swift (2), of the Pennsylvania State College, in 1926 analysed glandular organs and common cuts of meat for iron content. Figures from these sources were used as a basis for calculations. The United States Department of Labor Bureau (3), publishes monthly the average retail prices of about forty food commodities for fifty-one cities in various sections of the United States. In determining the economy of iron in different parts of the country, six of these fifty-one cities were selected to represent different regions. Kansas City prices were used in determining the relative

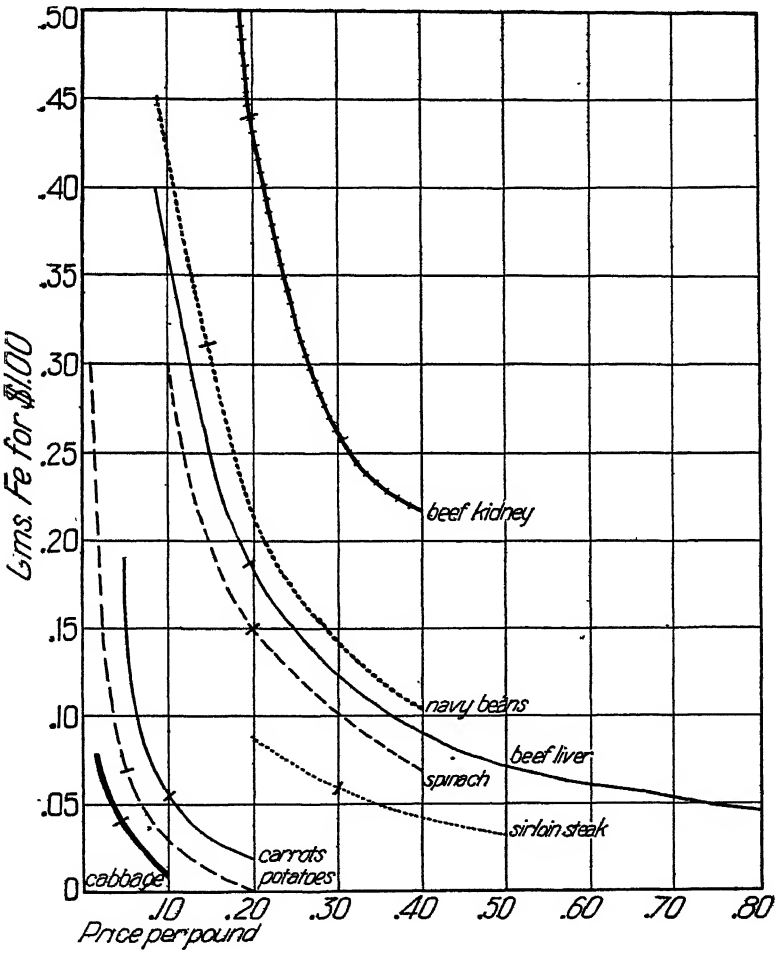

CHART III. Variations in the amount of iron received for $1.00 spent for certain foods, as the price of food per pound varies.

economy of iron sources at different months of the year. The prices for the year 1928 were used in calculating costs.

Since foods are in general sold by the pound, it seemed possible to relate the price per pound to the amount of iron received at that price for an expenditure of $1.00. From the per cent of iron in foods as given by Elvehjem and Peterson (1) and Forbes and Smith (2), calculations were made to show the amount of iron that could be secured for $1.00 with foods at different price levels.

Chart I shows the variation month to month in the amount of iron received for $1.00 spent for a food in Kansas City in 1928. Chart II shows the iron received for $1.00 in the different regions of the United States in December, a few foods only used for illustration. Chart III shows the grams of iron received for $1.00 spent for certain foods, the foods varying in price per pound. The return in iron for an expenditure of $1.00 grows smaller and smaller as the price per pound increases.

Conclusions

A method has been shown for comparing the relative economy of different foods as sources of iron. This has been applied to foods at prices prevailing in different months of the year and in different regions of the United States. Comparisons might be made in various ways. In this instance, it seemed clear to compare the amounts of iron in foods secured for a uniform expenditure of $1.00. This method does not hold for iron alone but might be used to show the relative economy of various foods as sources of other dietary essentials.

Literature Cited

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2. Forbes, E. B., and Swift, R. W., 1926, J. Biol. Chem., 67, 517.
3. United States Department of Labor Review, 1928 and 1929.

SOME OBSERVATIONS OF THE EFFECT OF THE ADDITION OF IRON TO AN ADEQUATE DIET

Contribution No. 8 Department of Home Economics

MYRA T. POTTER AND MARTHA M. KRAMER

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Introduction

Investigations have shown that nutritional anemia can be produced in young rats by feeding a milk diet. The anemia seems to develop in a rather short time when the young rats have been reared on the Sherman stock ration, a ration which has proved satisfactory in this and other laboratories. It was, therefore, thought of value to study this standard diet by adding iron and observing the effect on the hemoglobin content of the blood of the animals.

Historical

Titus, Cave and Hughes (1) in their study of the manganese-copper-iron complex as a factor in hemoglobin formation, found that in two to six weeks, anemia could be produced by feeding a milk diet to young rats. The rats for this experiment were taken at four weeks of age from our stock colony, which has always been fed the Sherman ration. In this same study it was found that rats having a fairly high amount of hemoglobin in their blood were able to utilize iron to some extent; on the other hand, anemic animals were unable to utilize iron. This coincides with the findings of Hart and coworkers (2) in which they found anemic animals receiving 0.0005 grams of iron daily failed to increase the hemoglobin materially.

Experimental

Twenty rats, four weeks of age, were taken from their mothers, ear marked and placed in individual wire cages with screen bottoms. The animals were fed the Sherman ration ad libitum in small stoneware jars. This ration was composed of two-thirds ground whole wheat, one-third dried whole milk powder, and two per cent sodium chloride based upon the weight of wheat. Distilled water was supplied in glass containers.

One-half of the rats received 0.0005 grams of iron, the other half received 0.00025 grams per day, six days in the week. The iron used was prepared from Mallinchrodt's iron wire of the purest grade, dissolved in Mallinchrodt's iron free hydrochloric acid, and treated with hydrogen sulphide under pressure to precipitate any copper which might exist as an impurity in the iron wire. A stock solution of the ferric chloride was made, dilutions being used to make solutions of the desired strength.

Each morning, the iron supplement was accurately measured into glass dishes containing a small amount of the Sherman stock ration. When the food containing the added iron was eaten, the animals were given their large dishes of food. This method was used to insure quantitative consumption of the iron.

For comparison, there were available hemoglobin determinations which had been made on a large number of rats receiving the regular Sherman ration with distilled water. These rats were cared for in the same way as those receiving additional iron, except they were not kept in separate cages.

The animals were weighed and hemoglobin determinations were made each week. The blood was obtained by pricking the caudal vein with a sharp scalpel a few centimeters from the end of the tail. A drop of blood was drawn into a hemoglobin pipette to a measured point and diluted to the mark with one-tenth per cent of sodium carbonate. The hemoglobin determinations were made with a Fleischl-miescher hemoglobinometer and findings were expressed in grams of hemoglobin per 100 cc. of blood.

Discussion

The animals in the three groups made consistent, good gains in weight and averages show no significant differences between the gains made by the three groups.

The animals receiving the Sherman ration plus 0.00025 and 0.0005 grams of iron daily showed a striking increase in hemoglobin between the fourth and fifth weeks. The hemoglobin after this time remained at about the same level.

The hemoglobin of the rats on the Sherman ration alone increased gradually. At the tenth week, their average hemoglobin level was similar to the level at the fifth week of the rats receiving the stock ration plus iron.

AVERAGE HEMOGLOBIN LEVELS OF THREE GROUPS OF RATS

	Sherman Ration		Sherman Ration +0.0005 gm. Fe.		Sherman Ration +0.00025 gm. Fe.	
Week	No. of Animals	Av. Hb. per cent	No. of Animals	Av. Hb. per cent	No. of Animals	Av. Hb. per cent
4						
5	48	8.46	10	8.46	10	9.52
9			10	13.27	10	13.00
7	44	11.58	10	13.49	10	13.53
8			10	13.76	10	14.28
6			10	13.23	10	14.82
10			10	14.50	10	14.44
11	20	12.33	10	13.79	10	13.93
12			10	14.50	10	14.36
13			10	13.52	10	13.11
14			10	13.08	10	13.08
15	10	14.28	10	14.04	10	13.30
18			10	12.98	10	12.90
	17	13.31				

Summary

A hemoglobin study was made on white rats using the Sherman stock ration. Ten rats received this stock ration plus 0.0005 grams of iron daily; ten others received the same ration with the iron level at 0.00025 grams. A large number of rats were used as controls.

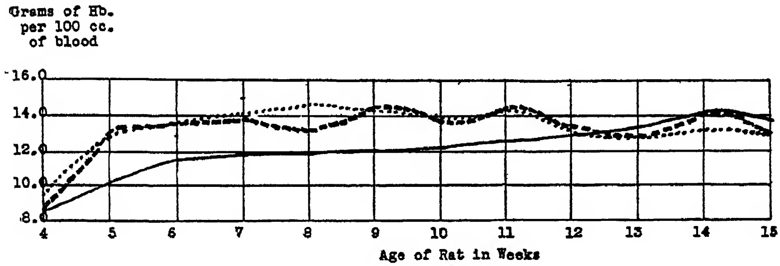

Chart showing average hemoglobin levels of three groups of rats.

Sherman Diet - Controls ——————

Sherman Diet +0.0005 gm. Fe. -

Sherman Diet +0.00025 gm. Fe.

It appears that with the Sherman ration, added iron influenced the hemoglobin levels until after the tenth week. There is a marked increase in hemoglobin between the fourth and fifth week, this increase being maintained throughout the experiment with slight fluctuations.

Control animals on the Sherman ration showed a gradual increase in hemoglobin. After the tenth week, the hemoglobin levels were similar for all groups.

The data from this study indicate that iron, when added to the Sherman stock ration, increases the hemoglobin content of the blood of the young rat.

Literature Cited

1. Titus, R. W., Cave, H. W., and Hughes, J. S., 1928, J. Biol. Chem. 80; 565.
2. Waddell, J., Elvehjem, C. A., Steenbock, H., and Hart, E. B., 1928 J. Bio. Chem., Vol. 77: 777.

STUDIES IN AUTOLYSIS. I. AUTOLYSIS IN SEEDS

ARTHUR WILLIS BARTON
Kansas State Teachers College, Hays, Kansas

Autodigestion has been a matter of research for nearly fifty years among physiological chemists. The original meaning of the term as given by Jacoby (1), who carried on the work started by Hofmeister in the latter part of the Nineteenth Century, is still accepted by workers. Jacoby gave the name, "Autolysis" to the process and has shown that the enzymes taking part in this action do not come from the digestive tract and are not pepsin or trypsin taken up by the cells. He designates as autolysis all enzyme actions which take place in the removed organs or fluids "without the aid of micro-organisms, but processes that occur intra vitam under certain conditions".

Plimmer (2) makes use of the term in a similar manner as follows: "Proteoclastic and other enzymes are present in all tissues; they are concerned in the breaking down of the constituents of the tissues and in their synthesis. They are the cause of the auto- or self-digestion of the tissues after death and in starvation food is supplied by the breaking down of some of the organs at the expense of other organs by the autolytic enzymes."

Robertson (3), says autolysis is "the spontaneous hydrolysis by their own enzymes". And Stokalasa, et al (4) affirm that "many plant tissues under sterile, anaerobic conditions produce alcohol, carbon dioxide and a small quantity of lactic acid. Protoplasm makes use of two enzymes in the first steps of respiration: first zymase and second, lactacidase".

Grimmer (5), in studying the action of proteolytic enzymes of food materials, found active autolytic changes in oats, horse beans, barley, vetch, etc., in neutral, alkaline and acid media. Wiener (6) says, "Autolytic changes take place best in an acid medium".

While some experimenters have taken care to secure sterile conditions, others have not. It is difficult to have a perfectly aseptic condition when animal tissues, such as liver, muscle, etc., are used. Owing to the universal distribution of micro-organisms, crushed plant and animal tissue become contaminated very quickly, and sterilization of a nature severe and thorough enough to kill all the organisms has a very deleterious action on the enzymes.

Experimental

These experiments[1] were undertaken with a view of ascertaining the maximum enzyme action under varying conditions of substrate and media and to determine the products of such autolysis.

In the beginning a great variety of seeds was tried in a more or less superficial manner. Under the conditions of the experiments all seemed to yield about the same products, mainly carbon dioxide, methane, nitrogen and hydrogen. Subsequently, work was confined to the small navy white bean and a few other seeds.

The seeds were always of the current season's growth showing nearly 100 per cent germination. They were ground under as favorable conditions for sterility as possible in a power grinder and kept in glass stoppered bottles. Five grams were used as a charge in each experiment with or without preservative, activator, other substrate, etc. Each experiment was carried out in five-pint bottles arranged in a series of four or five. Through the two-hole stopper in each bottle a long and a short right-angle glass tube was so connected with thick-walled rubber tubing that when the gas formed in bottle No. 1 passed into bottle No. 2 through the short tube, the water in this bottle forced the water out of the bottles of the series and finally into a measuring cylinder, where it was recorded and emptied from time to time.

The bottles were cleaned thoroughly, treated with sulphuric acid-potassium dichromate solution, rinsed, plugged with cotton, and sterilized in an oven at 150°C. Stoppers, tubing, etc., were similarly treated. After being connected in series of four or five, boiling water was drawn into the bottles by suction until all were full. When at room temperature, the water in the bottles was saurated with washed, sterile gas from a cylinder of liquid carbon dioxide.

A brief summary of some of the experiments will give an idea of their behavior.

No. 8. (5 bottles in series), 5 grams of beans, 20 grams sterile glucose, 2 grams sterile microcosmic salt, and 10 grams sterilized ammonium sulphate. By the third day enough gas had been generated to force out 140 cc of water. The action continued for eighteen days forcing out over 9,000 cc of water.

No. 10. (Five bottles in series), 5 grams of beans, 5 grams of pepsin, 20 grams of sterilized glucose, 2 grams microcosmic salt, and 10 grams of sterilized ammonium sulphate. After three days 70 cc of water had been displaced. Action continued until the 12th day. Total displacement, 9,600 cc of water. Bottle No. 1 (containing the charge) contained 0.276% alcohol, double distilled.

No. 15. 5 grams of beans, 20 grams of sterile glucose. Vigorous action had commenced by the end of the third day, continued 18 days, expelling 6554 cc of water during the time.

Various modifications of these experiments were tried during subsequent years, while the conviction grew that much if not all the action was due to micro-organisms. In an attempt to secure not only absolutely sterile conditions of enzyme as well as of substrates and media, the following method was tried.

Four-ounce wide-mouth bottles were filled with 3-hole stoppers filled with two right angled glass tubes and, a bent glass rod flattened at the lower end for crushing the seeds. A layer of glass wool was put in the bottom of each bottle, and they were filled with sterilized water, and, in some cases, saturated with carbon dioxide.

Whole beans were used in the experiments, treated as follows: five dry seeds were immersed in sulphuric acid-potassium dichromate solution two minutes, washed in 95 per cent alcohol three minutes, then rinsed in distilled water and placed in bottle No. 1 of the series previously described. Various substrates such as glucose, lactose, etc., and different salts all carefully sterilized were used. After soaking 48 to 72 hours the beans were crushed by the flattened glass rod and allowed to stand from 30 to 90 days, or even longer, at room temperature. In no case was any gas generated. In other instances the beans were not crushed, but after 30 to 90 days soaking, the water was forced out of bottle No. 1, containing the beans, by means of sterilized, washed oxygen leaving the beans resting on the glass wool. Enough water was held by the wool to keep the oxygen saturated. In from three to five days from 60 per cent to 100 per cent of the seeds had germinated, thus proving the vitality of the seeds had not been destroyed by the rather severe method used in sterilizing them. In some cases the seedlings were allowed to grow as long as they would, becoming twisted and bent as they filled the bottle but remaining green and showing no signs of decay save the normal shrivelling of the cotyledons.

Conclusion

It is apparent from these experiments that (1) in beans and other seeds not thoroughly sterile, disintegration of the seed and other substrates begins in a few days and runs to completion in from 10 to 20 days. But (2) where complete sterilization is effected no autolytic changes occur. Germination takes place subsequent to restoration of conditions that are favorable thereto, showing that any changes that may have taken place are not of great physiological importance.

These experiments cast considerable doubt on the so-called autodigestive changes commonly known as autolysis as far as seeds are concerned and raise the question: "May it not be that micro-organisms are the cause of autolysis in animal tissues?"

1. This work was started in 1925 at the University of Washington, Seattle.

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1. Jacoby 1902 Ergebnisse der Physiol. II
2. R. H. A. Plimmer 1915 Practical Org. and Biochemistry, p. 396.
3. Robertson 1920 Physiological Chemistry, p. 177.
4. Stoklasa, Ernst & Chocensky 1907, Z. f. physiolog. Chem., 56:303.
5. Grimmer 1907 Biochem. Z., 4:80.
6. Wiener 1904 Centralbl. f. Physiolog., 19:349.

THE EFFECT OF LONG-CONTINUED SOAKING ON SEED GERMINATION

ARTHUR W. BARTON

Kansas State Teachers College, Hays, Kansas

In some of the experiments on autolysis in seeds*, it was thought worth while to see what influence soaking for long periods of time would have on the germination of seeds under the conditions therein mentioned. But after soaking for three months or more, it was found that they do not decay, generate gas, or show any signs of autolytic or enzymic action.

Experimental

Following the procedure of the experiment on autolysis, four-ounce bottles were sterilized and fitted with two-holed stoppers in which were right-angled glass tubes for connection in series. Each series was filled with boiling water, when at room temperature, the water was saturated with carbon dioxide. Five whole seeds treated as follows: the dry seeds were immersed in sulphuric acid-potassium dichromate solution for two minutes, washed in 95 per cent alcohol, and washed in sterilized distilled water, then placed on the glass wool in the first bottle of the series. After remaining in the water for varying lengths of time up to three months, the water in bottle No. 1 was forced out with sterilized oxygen. The gas was kept saturated by the layer of water left in the glass wool. In from three to five days from 60 to 100 per cent of the seeds germinated. Some of the seedlings were allowed to remain in the bottles for several months, becoming twisted and bent to conform to the shape of the bottle but remaining green and healthy looking. Seeds of navy beans, peas, corn, and wheat, were used in the experiments.

Conclusion

It would seem from these experiments (1) that the capacity for germination is not destroyed by long continued soaking in sterile media; (2) that destructive changes are not brought about by enzymes or ferments within the seeds; and (3) that any change that may take place within the seed does not in any way effect the viability and is not accompanied by any visible manifestation.

*Trans. Kan. Acad. Sci. 32:34.

THE BEHAVIOUR OF CERTAIN LYOPHILIC COLLOIDS IN LIQUID AMMONIA

ROBERT TAFT

University of Kansas, Lawrence, Kansas

Paper No. 14 of the 1927 annual meeting at Lawrence, accepted for publication July 15, 1929

During the last thirty years Franklin and his students have extensively investigated the properties of liquid ammonia as a solvent for inorganic and organic substances. Little or no attention has been paid to its ability as a colloidal dispersion media. For that matter, but little systematic work has been made with dispersion media other than water.

The following brief literature review, while probably not complete, includes all of the information which could be located after a careful search upon colloidal systems in liquid ammonia.

In their extended list of qualitative solubilities Franklin and Kraus[1] list the following substances, chiefly the observations of Gore, which in other liquids, form colloidal systems:

Hemoglobin, slightly soluble; gum copal, very slightly soluble; gun cotton[2], slightly soluble; Bengal silk, insoluble; tannic acid, slightly soluble; starch, swells up and mixes with water;[3] isinglass, semifluid; gutta percha, action.

Ostwald[4] has suggested the possibility that metallic sodium and elementary sulfur disperse in liquid ammonia rather than dissolve to form true solutions. His point of view lacks definite experimental evidence and will be discussed in a later paper.

Fenton and Berry[5] and Clancy[6] have pointed out that cellulose nitrates and acetates can be dispersed in liquid ammonia.

Koch, Cahan and Gustavson[7] have used liquid ammonia to concentrate the antirachitic factor in irradiated cholosterol. The factor might doubtless be colloidal in character.

There are doubtless other stray observations on systems of colloidal character in this medium. As is well known, many dyes of high molecular weight are distinctly colloidal in character in aqueous systems. Some of the observations on the solubility of dyes in liquid ammonia[8] would probably include those of colloidal character.

Perrin has proposed the names of lyophilic and lyophobic for the two main classes of colloidal systems. Lyophilic for that class of substances (in the main spontaneously dispersable) in which considerable forces of attraction exist between disperse phase and dispersion media; lyophobic (usually not spontaneously dispersable) for that class of substances in which the force of attraction between disperse phase and dispersion media is not so marked as in the previous class. It is with the first class of substances that this paper is concerned. The procedure used to determine the dispersability of a

number of such substances was to draw 50 cc of commercial anhydrous ammonia into an unsilvered Dewar vessel, add approximately a gram of test substance, the system being then allowed to stand loosely corked in a bath of liquid ammonia. Observations were made from time to time with respect either to the swelling or dispersability of the substance in question. In a few instances observations were carried out at room temperatures. It was necessary under these conditions to place the liquid and the test substances in a tube which was then sealed.

The results of these observations are tabulated below:

Disperse or Swell in Liquid Ammonia at Its Boiling Point

Substance	Remarks
Gelatin	Swelling slight
Glue	Swelling slight
Pectin	Disperses readily
Cellulose penta-nitrate	Disperses readily
Cellulose tetra-nitrate	Disperses readily
Cellulose acetate	Disperses readily
Corn starch	Yields thick paste
Potato starch	Yields thick paste
Gliadin	Disperses readily
Albumin	Swelling and dispersion slight
Rosin	Disperses readily
Glutenin	Fair dispersion
Dextrin	Disperses readily
Gamboge	Disperses readily
Congo-red	Disperses readily
Benzopurpurin	Disperses readily

Do Not Disperse or Swell in Liquid Ammonia at its Boiling Point

Pale crepe rubber	Gum tragacanth
Vulcanized rubber	Gum arabic
Soaps (hard or soft	Sodium silicate (commercial, dry)
Agar	Cotton cellulose
Silk	Filter paper

In the cases where dispersion has taken place it should be noted that the fact of dispersion does not prove that the substance in question has the properties of a lyophilic system, nor even that it is colloidal. However, the phenomena of swelling, the production of exceedingly viscous systems upon increasing the concentration in certain cases[9] point to the fact that in the majority of these cases we are dealing with typical lyophilic systems. At the present time we are investigating the dispersability of a far more extensive list of substances from both a qualitative and quantitative standpoint.

Use of Liquid Ammonia Salt Solutions as Dispersion Media

Williams[10], von Weimarn[11] and others have pointed out that certain substances, such as cellulose, silk fibroin, casein, chitin, etc., which do not disperse spontaneously in water will do so in concentrated aqueous solutions of very soluble salts. A few experiments of similar character were carried out in liquid ammonia, using lithium iodide and barium thiocyanate as the salts. These salts are extremely soluble in liquid ammonia, solutions of such concentrations that their boiling points are above room temperature, i. e., having a boiling point elevation of greater than 60° C.

By the use of a concentrated solution of barium thiocyanate in liquid ammonia, cellulose (filter paper) could be dispersed. Sufficient cellulose could be dispersed so that a stiff jelly was formed. Solutions of lithium iodide in this solvent gave negative results for the dispersion of cotton. Saturated solutions of ammonium nitrate and sodium thiocynate were likewise unable to disperse cotton under the conditions employed.

A concentrated solution of lithium iodide did disperse silk, however. The action here is one of chemical disintegration as the process took place slowly (one week for complete dispersion) and the resulting system did not reprecipitate the silk upon dilution with large volumes of water.

Evidence for a Lyotropic Series in Liquid Ammonia

Hofmeister some years ago pointed out that aqueous salt solutions varied in their ability to disperse albumin. In the case of those solutions possessing a common cation the variation in dispersing effect was ascribed to the nature of the anion present. Similar effects were noted for many other salt solutions and other colloidal materials, and, consequently, the series of salts arranged in the order of their effect on a given property has been called the Hofmeister or lyotropic series. Some investigators have questioned the actual existence of such a series but the effect is so general that little doubt as to its existence now prevails. However, but little work has been done upon the existence of analagous phenomena in other dispersion media. The introduction of such evidence would lend added confirmation to the universality of such lyotropic effects. That various salt solutions of a given cation in liquid ammonia do produce varying effects in the dispersion of cellulose nitrate was shown in the following manner.

A number of strips of Mallinckrodt's pyroxylin were prepared, having dimensions of approximately 6x1x0.1 cm. and all weighing within 0.03 of a gram of 0.8 grams. These were immersed at the temperature of boiling ammonia in tubes containing liquid ammonia solutions of the following salts: sodium chloride, sodium nitrate, sodium acetate, pure ammonia, sodium iodide, and sodium thiocynate. The times for dispersion were noted, the longest requiring four and

a half hours. The order of decreasing time for complete dispersion is that given above. The salt solutions were approximately one molar with the exception of sodium chloride and acetate which were less than this but saturated. That the dispersing effect is also a function of the cation was shown by the fact that pyroxylin does not disperse in normal solutions of lead nitrate and of lead acetate in liquid ammonia.

1 Am. Chem. Jour. 10:820 (1898).
2 Compare observations of Clancy and of author as described below.
3 Kolloid Chem. Beihefte 2, p. 437 et seq. (1910-11).
4 Proc. Camb. Phil. Soc. 20:16 (1920).
5 U. S. Patents No. 1, 439:293 (1922); No. 15:544 809 (1925).
6 J. Biol. Chem. (No. 2); lii (1925).
7 Cf. Carli, Gaz. Chim. Ital. 57:347 (1927).
8 It is possible to prepare sols containing thirty to forty per cent of cellulose acetate or nitrate.
9 J. Soc. Chem. Ind. 40:221T (1921).
10 J. Ind. Eng. Chem. 19:109 (1927).

THE INFLUENCE OF GELATIN ON THE FORM OF ELECTRO-DEPOSITED COPPER

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It is well known that colloidal materials change appreciably the form of electro-deposited metal. This alteration of deposited metal may be due to several factors, two of which are: adsorption of the colloid by the cathode, and the electro-deposition of the colloid particle with the metallic ion.

Marie and Buffat*, as well as others, found that cathode deposits from electrolytes containing gelatin, were heavier than the theoretical deposit. These authors attributed this excess deposit to gelatin and mechanically held copper sulfate. The manner in which gelatin is retained is not known.

This excess weight of the deposit is a function of several factors, only two of which are reported in this paper. Current density, temperature, hydrogen ion concentration, and brand of gelatin are among the variables not considered. The two variables which are here considered are concentration of copper sulfate and concentration of gelatin in the electrolyte.

A series of experiments was made in which to study these two factors, namely, the concentrations of copper sulfate and of gelatin. Five concentration of the copper sulfate were used and each of these with three concentrations of gelatin, making fifteen electrolytic cells. Two coulometers were inserted in the circuit to give a measure of the quantity of copper deposited under normal conditions.

The materials used in this experiment were C. P. copper sulfate and Coignet's gelatin. Both anodes and cathodes were cut from sheet copper into squares, 2.5 cm. on an edge, and plated with copper preparatory to use.

The electrolytes were prepared in the following manner: Portions from a stock solution of 1.25 molar copper sulfate were diluted with water to make 100 cc. of the solutions ranging from 1.25 to 0.25 molar at intervals of 0.25. The dry gelatin was added and the sulfate solution warmed to 50°C. to hasten dispersion. Stirring was slow and continued until the gelatin had dissolved. These factors in the preparation of the gelatin solution were maintained as nearly uniform as possible since properties of colloidal solutions vary with

*Jour. Chim. et Phys., 24; 470, 1927.

their past history. Fifty cubic centimeters of each electrolyte were reserved for electrolysis and the remainder used for hydrogen ion determinations. The latter were determined with the quinhydrone electrode.

The conditions of the series were: temperature 30° C; current 0.125 amperes, (c.d. 2 amps. per square decimeter); length of run 30 minutes. The concentrations of copper sulfate and gelatin were the variables. The hydrogen ion concentration was a variable also, but in these solutions it was dependent largely upon the hydrolysis of the copper sulfate. No reagent was used to control the concentration of the hydrogen ion.

The following are the results of the experiment:

Cell No.	Conc. $CuSO_4$ Molar	Conc. Gel. per cent	Exc. Deposit milligrams	pH
1	Coulometer	0.00	0.0	----
2	1.25	0.00	not det.	3.02
3	1.25	0.06	1.0	3.09
4	1.25	0.50	2.9	3.16
5	1.25	2.00	4.3	3.25
6	1.00	0.00	not det.	3.16
7	1.00	0.06	1.2	3.25
8	1.00	0.50	2.7	3.33
9	1.00	2.00	4.5	3.41
10	0.75	0.00	not det.	3.31
11	0.75	0.06	1.1	3.41
12	0.75	0.50	2.9	3.49
13	0.75	2.00	4.3	3.58
14	0.50	0.00	not det.	3.47
15	0.50	0.06	2.1	3.60
16	0.50	0.50	2.7	3.68
17	0.50	2.00	4.5	3.78
18	0.25	0.00	not det.	3.75
19	0.25	0.06	2.3	3.88
20	0.25	0.50	4.3	3.99
21	0.25	2.00	6.3	4.06
22	0.00	0.00	---	6.15
23	0.00	0.06	---	5.62
24	0.00	0.50	---	5.47
25	0.00	2.00	---	5.38
26	Coulometer	0.00	0.0	---

Plate I shows graphically the relation between cathode deposit in excess over theoretical, and the concentration of gelatin. Curves 3, 4 and 5 are nearly identical, indicating that the excess deposit is independent of the exact concentration of copper sulfate, providing sufficient of the sulfate is present to give a deposit free from oxide. Curve No. 2 deviates some, and curve No. 1 is quite different. These cathodes from one-half and one-fourth molar copper sulfate solutions are discolored from the presence of the oxide, and it is this oxide which causes the abnormal increase in weight.

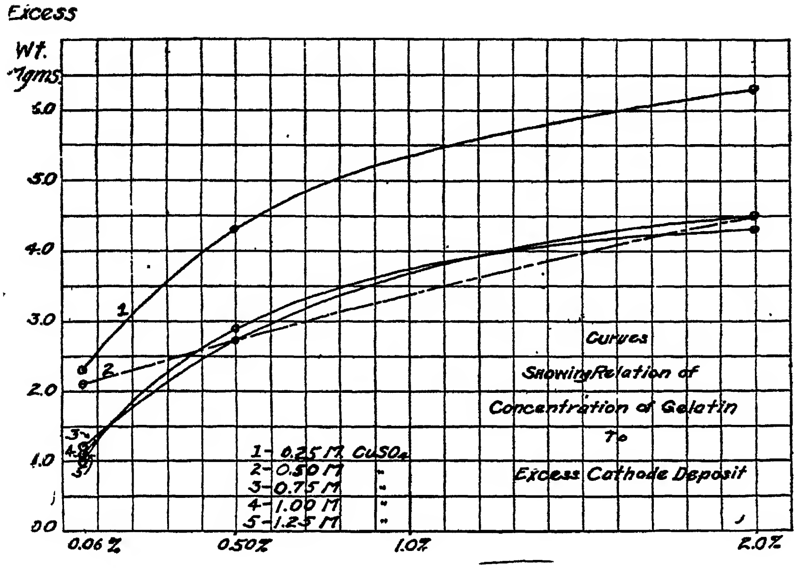

Plate I. Curves showing the relation of Concentration of Gelatin to Excess Cathode Deposit

The magnitude of the excess weight is a function of the concentration of the gelatin. In each case the more concentrated gelatin solutions give the heaviest deposits. It is this excess weight that Marie and Buffat (loc. cit.) attributed to mechanically held copper sulfate and adhering or including gelatin. The curves could have been extended to zero excess deposit, as representing the electrolyte with zero gelatin.

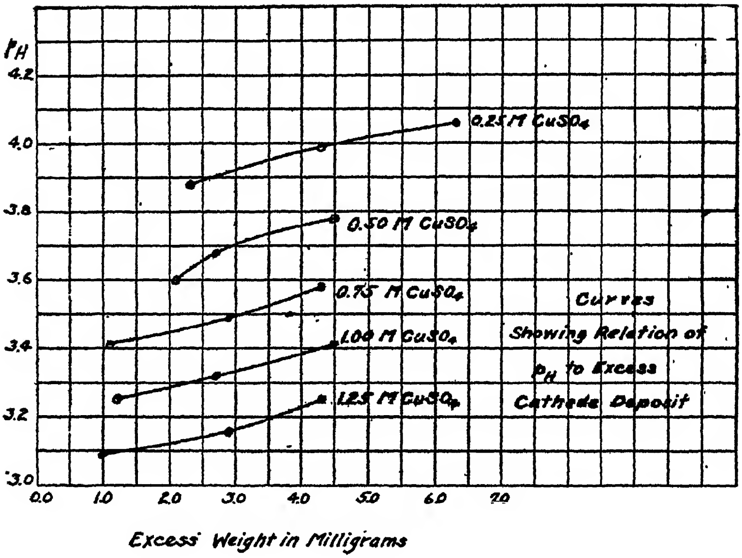

Plate II. Curves Showing the Relation of pH to Excess Cathode Deposit.

Plate II shows the relation between the excess weight in mill'grams and the hydrogen ion concentration, or rather the logarithm of the reciprocal of the hydrogen ion concentration, which is commonly termed pH. Each of the curves shows that, with copper sulfate remaining constant, the solution with higher pH gives a greater excess deposit. The higher pH in reality means less acidity.

Since no acid was added to the electrolyte the change in pH is largely the result of the hydrolysis of copper sulfate. When the concentration of copper sulfate is increased, the concentration of hydrogen ion increases. A 1.0 molar copper sulfate solution gives a pH of 3.16, which value corresponds to 7×10^{-4} gram mole of hydrogen ion per liter.

Variations in excess cathode weight may be proportional to concentration of copper sulfate and to the hydrogen concentration. These latter two variables are so closely associated to one another, that the effects due to one might easily be assumed as due to the other. Some evidence is available which would indicate that excess weight is a function of pH and nearly independent of the concentration of the copper sulfate. For this latter statement to be true

the copper sulfate electrolyte must be more than one-half molar. This idea is substantiated by curves 3, 4 and 5 on Plate I.

Plate II also shows the relation between the concentration of gelatin and excess cathode weight.. The curves for three-fourths, one, and one and one-fourth molar copper sulfate show a very uniform effect of the variation of gelatin content. The points to the extreme left of these five curves represent 0.06 per cent gelatin in the electrolyte; the points in the approximate center of each curve are the points representing 0.5 per cent gelatin, while the points on the right are for 2.00 per cent gelatin; with copper sulfate remaining constant, the greater will be the excess cathode weight.

Plate III shows the cathodes produced in this experiment. Several types of deposits are the result of the variation of the concentrations of the copper sulfate and the gelatin. The top horizontal row of cathodes is from the one and one-fourth molar copper sulfate electrolyte, the bottom row from the one-fourth molar copper sulfate, while the intermediate rows are from the corresponding copper sulfate solutions. The vertical columns from left to right show the electrodes from solutions containing respectively 2.0, 0.5, 0.06, and 0.0 per cent gelatin, with variable copper sulfate. The cathodes in the upper left portion of the plate are more or less of the same type. Those with the higher proportions of gelatin exhibit striations, while on those with less gelatin the striations are replaced by "dots". The direction of the striations and of the rows of dots is caused by convection currents within the electrolytic cell. The two lower horizontal rows show quite darkened cathodes. The dark color is in reality red to blue oxide of copper; it is this oxide that causes the abnormal excess weights. The formation of this oxide may be caused by one or more of several factors; too low acidity, too small concentration of copper sulfate; and too high current density.

When these latter conditions exist the tendency is for hydrogen to be liberated at the cathode. This removal of acid hydrogen leaves an excess of hydroxyl ions which in turn unite with the copper under reducing conditions to form cuprous hydroxide. The cuprous hydroxide then breaks down into oxide and water. It is this oxide that gives us the abnormal excess deposits on cathodes from dilute copper sulfate electrolytes.

Apparently the gelatin plays an important role. The effect of the absence of gelatin may be seen in the five electrodes in the vertical column to the right. In this case the variation of copper sulfate has little effect upon the appearance of the cathodes.

All the foregoing points will receive further consideration as this study continues.

2.0 % Gel. 0.5 % Gel. 0.06 % Gel. 0.00 % Gel.

1.25 M. $CuSO_4$

0.75 M. $CuSO_4$

0.50 M. $CuSO_4$

0.25 M. $CuSO_4$

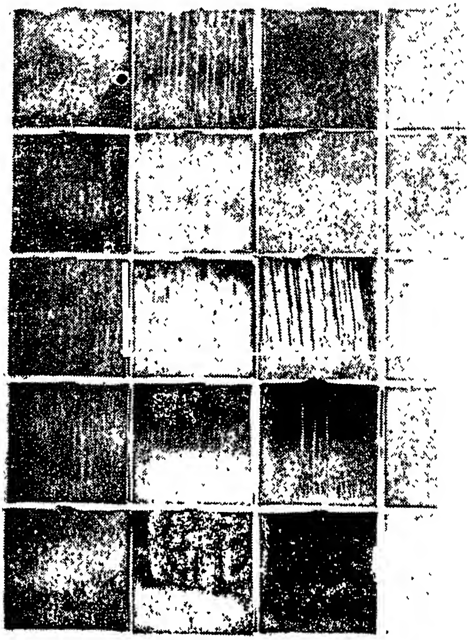

Plate III. Cathodes showing the form of Deposited Copper from Copper Sulfate-Gelatin Electrolytes. Actual size.

Plate III. Cathodes showing the form of Deposited Copper from Copper Sulfate-Gelatin Electrolytes. Actual size.

SOLVENTS FOR GUM ARABIC

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While studying the problem of the dispersibility of gum arabic and some of its colloidal properties it became necessary to make a search for dispersion media in order that its colloidal properties could be studied in systems other than water. As a result, an intensurvey of organic and inorganic solvents was made.

Gum arabic, or sometimes known as gum acacia, is a true gum, being completely soluble in water but not soluble in methylated spirits or turpentine as are true resins.

In order to obtain a pure uniform product for examination a large quantity of gum arabic was purified as follows: The gum was dissolved in as little water as possible, filtered to remove matter and then precipitated out again by addition of a non-solvent, ethyl alcohol. The precipitate was then drained free from alcohol and dried carefully. The product was then ground to a white powder.

The first determination made was that of the extent of solubility of gum arabic in water. It was found that at 25° that for each gram of gum arabic 1.7 grams of water were necessary. At 50° 1.6 grams of water, and at 90° C. 1.5 grams of water were necessary.

The next determination was the solubility of gum arabic in water and ethyl alcohol solutions. It was found that for a complete solubility of 1 gram of gum arabic an alcohol-water mixture of at least 54.5% water was necessary.

The rest of the determinations were made by noting the solubility in 25 cc. of various solvents and mixtures of solvents of 1 gm. of the gum at 25°, at 50° and at 75°. The following solvents were used:
Aliphatic alcohols: methyl, ethyl, propyl, amyl, butyl, glycerol.

Aliphatic esters: Ethyl acetate, 40 per cent ethyl acetate and 60 per cent ethyl alcohol, amyl acetate, 40 per cent amyl alcohol and 60 per cent amyl acetate. ethyl butyrate, ethyl caproate, diethyl carbonate, ethyl aceto-acetic ester.

Miscellaneous aliphatic solvents: formic acid, acetic acid, diethyl ether, dichlorethyl ether, acetone, chloroform, carbon tetrachloride, carbon disulfide.

Ethylene derivatives: ethylene glycol, dichlorethylene, trichloroethylene.

Aromatic Hydrocarbons: Benzene, toluene, xylenes.

Aromatic derivatives: phenol, nitrobenzene, aniline, dimethyl aniline, ethyl benzoate, benzyl benzoate, diphenyl ether, chlorobenzene,

40 per cent aniline and 60 per cent benzene, 40 per cent toluene and 60 per cent aniline.

Other solvents: pyridin; liquid ammonia at its boiling point.

The results of all these solvents for gum arabic were negative in character especially at lower temperatures. At the temperature 75° a very slight solubility was noted in the case of amyl acetate, ethyl acetate, the 40 per cent amyl alcohol- 60 per cent amyl acetate and the 60 per cent ethyl acetate-40 per cent ethyl alcohol mixtures. Otherwise the experiments proved that gum arabic is very difficult to dissolve in solvents other than water or certain water mixtures.

PHYSIOLOGICAL EFFECTS OF OXYGEN ATMOSPHERES DILUTED BY NITROGEN

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It was found several years ago in our experiments that small animals such as rats, pigeons, cats, guinea pigs and monkeys can live in a medium of air under confined conditions, but cannot live in pure oxygen under similar conditions; but will die within two to five days. In no case did any of the animals live over a week in oxygen except the snake which lived four weeks, while in the current of air we had the different animals confined for nearly three weeks without any signs of ailment.

In paper II the experiments were continued with guinea pigs in a mixture of 99.97 per cent of oxygen by volume and .03 per cent of carbon dioxide by volume. We took this amount of carbon dioxide since this is the average per cent found in our atmosphere. These experiments showed no difference in their habits and general conditions from those of pure oxygen.

We ran another series of experiments by substituting some inert gas for that of nitrogen, for example, argon and helium. By using seventy-eight parts of helium to twenty-one parts of oxygen, we could not observe any signs of ailments.

By using argon instead of helium and with the same percentage of mixture, the animals (mice) would not survive as they did with helium. The argon mixture would diffuse through the living cells less rapidly than the natural air and helium more rapidly. The density of nitrogen compared to air is .967, argon 1.379, and helium .138, and this might account for the difference.

By increasing the oxygen from twenty-one by volume to twenty-five, and decreasing the argon from twenty-eight to seventy-five, we observed that in this mixture normal life was supported for ten days. The general condition, respiration, appetite, rest, etc., were just as normal as if in pure air.

In the next series we used nitrogen instead of argon. Seventy-eight parts of nitrogen and seventy-one parts of oxygen were used as we have in the normal atmosphere—leaving out the rare gases, carbon dioxide, etc. The purpose of this series was to find out whether the rare gases, etc., had any influence on animal life. White mice were used as experimental animals.

The experiments were repeated six times for this series. At the

same time we were running those with an atmosphere without rare gases. we were running others with the normal atmosphere including the rare gases. We could observe no difference in physiological effect with the latter, that is, those under control with the normal atmosphere with those not under control.

Those in an atmosphere of seventy-eight parts of nitrogen and twenty-one parts of oxygen, leaving out the rare gases under control, without a single exception died within a few days.

This series of experiments led to the conclusion that the rare gases such as argon, helium, neon, krypton, and carbon dioxide, are vital to normal respiration of life.

SYNTHETIC DIAMONDS

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Synthetic diamonds were first made by Moissan, a French chemist.[1] Since his work in the nineties no special progress has been made in the laboratory preparation of diamonds. Considerable work by different chemists has been done since, but as just stated, with about the same results as those of Moissan.

Moissan's method, the supersaturation of molten Swedish iron by pure sugar carbon and attempted crystallization of the carbon by sudden cooling in cold water, was followed in principle. He believed that the tremendous internal pressure created by surface contraction of the globule aided crystallization.

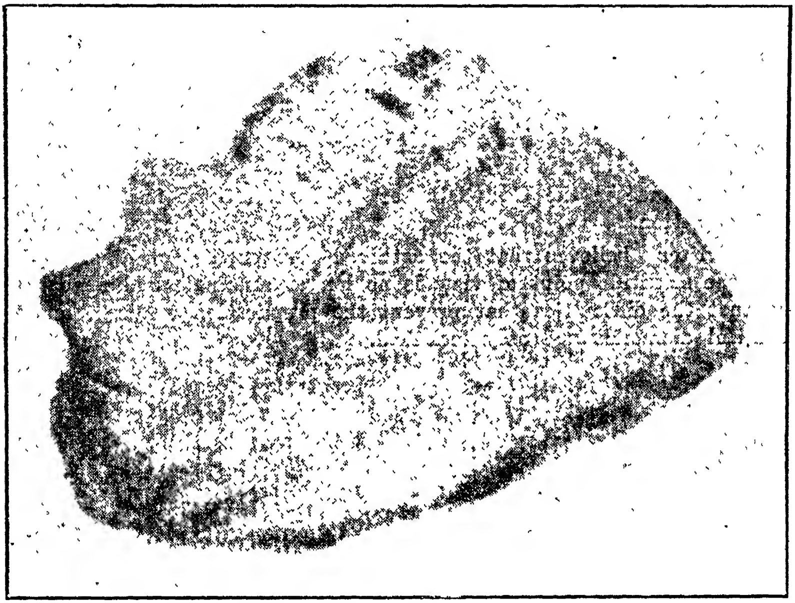
In a recent article that appeared in Nature (London), May 19, 1928, was treated the problem of the artificial construction of diamonds. The author, who is known as C. H. D., refers to the experimenters, among whom are Crooks, Parsons, and others. He believes that no experimenter has as yet succeeded in producing diamonds in the laboratory.

In the Philosophical Magazine, March, 1929, in an article written by Sesta, the statement that no synthetic diamonds were ever made in the laboratory was discussed. In brief it is stated that undoubtedly the works of Professor La Rosa escaped the attention of the above mentioned authors. Professor La Rosa claims that there might be some strength for the objections raised against the methods of Moissan and his followers, yet it can be asserted that these are groundless in the cases examined.

He further states that the results of the experiments and the ac-

[1]Ann. de Chimie et de Phys. 1896.

curacy of the method are sure proofs which lead us to withdraw from the ultimate conculsion arrived at by C. H. D.



SYNTHETIC DIAMOND—MAGNIFIED 75 DIAMETERS

Several years ago the writer with some of his students undertook to continue the work of Moissan and others, at McPherson College. The general methods of procedure were much the same as those of Moissan but the details were somewhat different.

We first used sand crucibles but later graphite. The crucible was filled with a mixture of two parts iron filings to one part pure sugar carbon by volume. Later we varied the percentage of sugar carbon and iron filings to see whether the results would be the same. We have found so far that it is best to use less carbon and more iron. The mixture was liquefied in an electric furnace at approximately 2500° C. or higher. The white hot contents and the crucible were plunged into a vat of ice cold salt water. The surface contraction created the desired internal pressure. The mass was dissolved in aqua regia. The residue, largely composed of amorphus carbon, was digested in hot concentrated hydrochloric acid with dissolving potassium chlorate, followed by hot concentrated sulfuric acid with dissolved potassium nitrate, which destroyed most of the carbon. The residue left from this treatment was treated with hydrofluoric acid.

The residue after chemical treatment was examined for diamond particles and it was always found to have a lot of flaky graphite.

The form of these crystals is quite different from that of diamonds.

Besides using liquid iron as a solvent for the carbon we tried nickel steel with a high coefficient of contraction, manganese steel, and extremely hard meteorite iron which showed no contrasting results.

We varied the current by using different amperage and voltage. The largest diamond made at McPherson College is four times as large as the largest made by Moissan or any one else so far reported. So far as the writer knows, no other genuine diamonds were ever made in the United States other than those made under his supervision.

The writer believes that the artificial construction of diamonds from the scientific point of view is no longer an unattainable goal, and that the difficulties that prevent the preparation of large and beautiful diamonds are only technical.

SOME FACTORS AFFECTING AMOUNT AND NATURE OF FLORA IN CENTRAL KANSAS

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The purpose of this article is to analyze investigations of the ecological conditions involved in the production of the xeric flora found on certain prairie remnants still existing, and lying near a central line running north and south through Kansas. Some of these investigations have been carried on by the writer over a period of years dating back as early as 1900, but a more intensive study has been made during the last four years. The particular prairie remnants on which the investigations were conducted are located in Lincoln, Harvey, and Sedgwick counties. For comparison, similar work was carried on in each of the counties and similar results were obtained. The data as discussed in this paper are those that were recorded from the work carried out on the Lincoln county area as they are representative of the other counties.

Investigations were conducted to ascertain the effect of the humus content of the soil on the nature and abundance of the flora.

Ten samples of soil were taken from each of the exposures under consideration: that is, level plain, valley, south slope, and north slope. The ten samples from each location were mixed and carefully dried at 90°C. and then pulverized. The samples were then exposed to a temperature of 312°C. until no more loss in weight was evidenced. The greater part of the loss being humus, these results were taken for a basis for comparison as to the amount of humus in the different exposures. The average percentages of humus content of the plain and south slope were nearly the same, being 2.8 and 2.7 per cent respectively. That of the north slope was 4.7 per cent and that of the valley 6.3 per cent. From these results it might be supposed that there is some relation between the amount of humus present in the soil and the amount of vegetation produced. However, the relation is not marked as may be seen by the following table.

Average weight of vegetation per square meter	Per cent of soil humus.
Plain—618 grams	2.8
Valley—3615 grams	6.3
South slope—255 grams	2.7
North slope—1835 grams	4.7

The amount of vegetation was determined by carefully gathering and weighing all of the vegetation from each of five separate square

meters at each exposure under consideration and the everage taken. The weights in the table are of the freshly gathered vegetation as no means were available for properly drying large amounts.

Since the valley produced 5.8 times as much vegetation as the plain it might be concluded that the valley soil is proportionately rich in humus. Such is not the case, as is shown by the above data, for the humus content of the valley is only 2.3 times that of the plain. Also, the north slope produced only 0.5 as much vegetation as the valley, yet its humus content is 0.75 as much. These facts show clearly that other environmental factors than humus content of the soil affect the production of vegetation.

It may be shown that there is a very close relation between the rate of evaporation and the amount of vegetation produced. To secure data for this proof, an average size plant was transplanted near each station where the data for the preceding discussion were secured. These plants were placed in pots and sealed so that there could be no evaporation from the freshly exposed soil, and the plants were then left in their natural habitat. Each was weighed and left for one hour and weighed again. The plant was then cut off and weighed, and the percentage loss of weight was computed. Also, in this experiment the leaf area in each case was carefully measured, and the loss by transpiration per square inch per hour was calculated. The loss per square inch leaf area of the plant from the plain was 0.68 grams, and that of the valley only 0.13 grams; hence the evaporation from the plain plant was 5.2 times as rapid as that from the valley. Therefore, it follows that the valley should produce 5.2 times as much vegetation as the plain, other conditions being equal; and such is nearly true, the actual amount being 5.8 times as much as previously shown. The north slope showed an evaporation of 1.7 times as much as the valley, which would mean, if other factors were equal, that the valley should produce 1.7 times as much vegetation. As shown by the above data, the valley produces 2.0 times as much as the north slope; therefore it appears that there is a very close relation between rate of evaporation and plant growth.

The great variation in the amount of vegetation produced on the different exposures might be supposed to be entirely dependent on the amount of soil moisture present. To reach a conclusion regarding this point five samples of soil were collected from different depths (six, twelve, and eighteen inches) at each exposure under consideration. It would have been desirable to have made tests at greater depths but it would have been impossible to have carried these out in a uniform manner because of the rocky subsoil. The first samples of soil were taken eight days after any moisture precipitation had occurred. During the following six days no more moisture fell and at the end of this period other samples were collected as before. These samples were considered to be a fair basis for determining

the average amount of soil moisture in that they were not secured during extremely wet or dry periods.

These samples were weighed and then kept at a temperature of 100°C. until they ceased to decrease in weight. They were then weighed again and the loss taken to represent the amount of moisture that each contained. The percentage of moisture for the plain was found to be 11.1 per cent, for the valley 29.1 per cent, for the south slope 10.7 per cent, and for the north slope 23.5 per cent. From these facts it might be supposed that the valley exposure should produce 2.6 times as much vegetation as the plain exposure since it has that many times as much moisture; but in reality it produces 5.8 times as much per square meter, as was previously shown. By means of the same reasoning the plain should produce only 1.04 times as much as the south slope; but again such is not true for the actual weights show that the plain produces 2.5 times as much as the south slope. This proves conclusively that there is little relation between the amount of soil moisture and the amount of vegetation produced. It does not prove, however, that the soil moisture has no effect, but that it does not have as great an effect as might be supposed.

In order to reach a conclusion as to whether there is a direct relation between the mechanical composition of the soil and the amount and nature of the vegetation, a study of the mechanical composition was made. From each exposure under consideration ten samples of soil were taken to a depth of twelve inches. The samples from each exposure were mixed in order that a fair average might be obtained for each exposure. These mixtures were thoroughly dried and then pulverized, though not enough to break up the natural texture of the soil. Fine gravel was considered to be of a size from 1.1 mm to 2.0 mm in diameter, coarse sand from 0.5 mm to 1.0 mm, medium sand from 0.25 mm to 0.5 mm, fine sand 0.1 mm to 0.25 mm, very fine sand 0.05 mm to 0.1 mm, silt 0.005 mm to 0.05 mm, and clay from 0.0000 mm up to 0.005 mm in diameter.

Since the fertility of the soil might be supposed to be based on the amount of humus content and since the humus is mostly combined with the finer parts of the soil, the conclusion might be that the percentage of clay and silt would be closely related to the amount of vegetation produced. It was found that in the soil of the plain exposure there was a 5 per cent clay and 15 per cent silt, a total of 20 per cent; in the valley 7 per cent was clay and 10 per cent silt, a total of 17 per cent; on the south slope 3 per cent was clay and 8 per cent silt, a total of 11 per cent; and on the north slope 8 per cent was clay and 14 per cent was silt, a total of 22 per cent. The above totals doubtless contained a large percentage of the humus present in the samples of soil. Upon weighing the vegetation on a square meter, as previously recorded, the plain yielded 618 grams, the valley 3615 grams, the south slope 255 grams, and the north slope 1835

grams. Comparing these results with the above data gives evidence that there is little relation between the mechanical composition of the soil and the amount of vegetation produced. This conclusion is drawn from the fact that the soil of the plain contains 3 per cent more fine soil than the valley, yet it produces only 0.17 as much vegetation; while the north slope contains 5 per cent more clay and silt than the valley but produces only 0.5 as much vegetation.

The temperature of the soil was taken at each of the exposures under investigation at the depths of three, six, and eighteen inches. A centegrade thermometer was lowered into a hole made by the use of a one half inch rod, a separate hole being made for each depth. Before each reading the thermometer was left in place five minutes. Readings were taken every four hours during the day and the temperature recorded. The range between the maximum and minimum temperatures of the plain at a three inch depth was 11.2°; at six inches, 3.3°; and at eighteen inches, 2.5°. The range for the valley at three inches was 6°; at six inches 1.4°; and at eighteen inches 1.7° C. For the south slope the range at three inches was 11.6°; at six inches, 4.7°; and at eighteen inches, 2.5° C. The range of the north slope at three inches was 4.4°; at six inches, 1.9°; and at eighteen inches, 1.8° C.

From these data it may be seen that the large variations in soil temperatures are in the plain and south slope exposures. This would be expected for the south slope is the most directly exposed to the sunlight because of the angle at which it lies in respect to the sun's rays, and the plain is almost as directly exposed and therefore has nearly as high soil temperatures. These high soil temperatures are accompanied by a large range in the atmospheric temperatures, and this large range, or variableness, may be as detrimental to plant life as the high soil temperatures for it demands more adjustment on the part of the plant to meet the changing conditions, thus resulting in a weakening of the plant.

In the valley and on the north slope the soil temperatures at the different depths are much lower, and also the ranges from the lowest to the highest of the day are much less than those of the south slope and plain. These conditions are the result of the sun's rays not reaching these exposures at angles as direct as those of the other exposures. Also, these exposures are not affected greatly by the hot winds because of their contour and also because of the more dense covering of vegetation.

The plain and south slope have the greater range, as well as the higher soil temperatures, but produce smaller amounts of vegetation as compared to the valley and north slope which have a smaller range, as well as lower soil temperatures. The conclusion follows that extremely high soil temperatures accompanied by wide range during the day are not conducive to the best development of plant life.

By way of summary it may be said that in xeric conditions as exist in Central Kansas there seems to be little relation between the mechanical composition and humus content of the soil and the amount of vegetation produced. Also, the amount of moisture in the soil, above a minimum amount, seems to have little effect on the nature or amount of plant life. But if the results of these investigations have been correctly interpreted the range of soil temperature and the rate of evaporation are in direct relation to the amount of vegetation produced. The flora of Central Kansas is xerophytic and is the result of successful adaptations to withstand conditions that are conducive to rapid evaporation.

A PRELIMINARY REPORT ON A SURVEY OF THE WATERS OF KANSAS TO DETERMINE THEIR IODINE CONTENT

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In the last few years, since we have a better understanding of the relationship of goiter to the iodine intake of the body, there has been aroused a considerable interest in the sources from which we get our iodine and the amounts available.

There is no question that a certain minimum amount of iodine is necessary for the maintenance of health. A deficiency of this element brings on the disease known as goiter in its common form, or at least is the most important contributing factor thereto. Just what amount of iodine is necessary or best for the human body is not quite so certain. It is possible that too much is harmful, especially in cases of certain kinds of goiter, although this is yet a disputed question.

Iodine may be derived either from our food supply or from the drinking water, or from both of these sources. There are certain forms of food, especially sea foods, which contain relatively large amounts of this element. These foods, if eaten frequently and in fair quantities, would be a sufficient source of iodine. Many of our foods, on the other hand, carry only very small quantities of iodine which varies not only according to the kind of food, but also with the character of the soil on which the food is produced, and upon the iodine content of the water supplied for irrigation. If the water is rain water only, then the iodine in the soil is the only factor concerned. A considerable amount of investigation of the iodine content of soils and of different minerals commonly found in soils has been done recently by J. F. McClendon of the Laboratory of Physiological Chemistry, University of Minnesota.

The easiest and surest way to maintain the iodine supply for the body would be to get it from the drinking water, provided this contained enough to satisfy the requirments. The amount we need is very small. There is in the body of the normally healthy person at any one time about 20 milligrams of iodine, from 8 to 10 milligrams of this being in the thyroid gland, the maximum capacity of which is 25 milligrams. The blood, according to Kendall, contains an average of about .013 milligrams per 100 cc. Experiments indicate that less than one milligram of iodine taken into the body daily is sufficient to maintain this amount. Boothby and Sainford have shown that one milligram of thyroxine (65 per cent of which is iodine) administered to a person shows an effect in maintaining a higher rate of metabolism in some cases as long as 70 days. If we

assume that the body contains 20 milligrams of iodine and that this decreases to the vanishing point in 70 days (which it probably does not do), then 40 milligrams distributed over 70 days or about one-half of one milligram per day would be sufficient to maintain continually this average amount, that is 20 milligrams. However, some recent experiments of Von Fellenberg seem to indicate that a much smaller amount than this is sufficient to maintain normal health so far as iodine is concerned. He finds that the normal intake of iodine in goiter-free regions is between .04 and .08 milligrams per day.

It should be of considerable interest to know whether each particular water supply contains enough iodine to supply the amount we need. It is a well known fact that certain localities show a much higher prevalence of goiter than others. Already some more or less definite relationship has been shown to exist between this prevalence of or freedom from goiter and the iodine content of the water and soil.

I have therefore set out to make a survey of the state of Kansas as to the iodine content of the city water supplies, as these supply the largest number of people. After studying the standard methods for the determination of iodine in water it seemed desirable to find an easier and quicker method than any so far in use. This was done by modifying a method used by Dr. Hunter of Cornell University for the determination of very small amounts of iodine in animal tissue. The method consists in oxydizing the iodine of the water to the iodate form by means of hypochlorous acid. The excess of chlorine is driven off by boiling. Potassium iodide is then added and the liberated iodine titrated by means of a standard solution of sodium thiosulphate. It is necessary to acidify the solution with a weak acid which itself has no oxidizing or reducing properties under the conditions of the experiment. A sufficient amount of a 50 per cent soluton of phosphoric acid meets these requirements and at the same time prevents any iron in the water from acting as an oxidizing agent. By this method we can liberate, for titration, six times as much iodine as was originally in the water. Consequently we can reduce the amount of sample to one-sixth of the amount necessary for other methods. Using as little as one liter of water and titrating with a N/2000 solution of thiosulphate, it is possible to get satisfactory checks on as little as 0.001 parts per million, or one part per billion of iodine in the sample. Less than this can safely be considered as none. This method was described in the Journal of the American Chemical Society of June, 1926, and it is not the purpose of this paper to go into details of methods.

So far about 75 samples of water, from cities and towns in as many counties in the state, have been analysed. The results of these tests show iodine contents ranging from one-tenth of one part per million to none at all or less than one part per billion. As some of these results need revision and further confirmation they are not

being published at this time. However, they are probably near enough to the truth to safely draw some general conclusions.

About 10 per cent of the samples contain no iodine. The average iodine content of 68 samples was about 0.03 parts per million, or, 0.03 milligrams per liter. This is larger than the amounts found in some other states where such surveys have been made. I am not surprised at this, however, because much of Kansas was covered by a large inland set in past ages. This sea has left its salt deposits which undoubtedly contribute some to the iodine content of the ground waters found here. If we assume that Von Fellenberg's conclusion that between .04 and .08 milligrams (say .08 milligrams) per person per day is sufficient, then one quart of water per person per day would furnish enough iodine in about 20 per cent of these samples, and 2 quarts of water per person per day would furnish enough iodine in about 50 per cent of the samples. Ten per cent of all the samples, as stated above, have no iodine. The other 40 per cent, although contributing to the iodine intake of the body, are not sufficient alone as a source of this element. If the water is from a deep well, and therefore comes from a distant source, it is important only as drinking water. If, however, it is from a shallow well or surface water, then it is indicative of the iodine content of the soil and is important from the standpoint of the vegetation grown upon this soil.

The addition of iodine to city water supplies has been advocated and actually carried out in some places, but this is a comparatively expensive and wasteful method of providing iodine as a very small proportion of the water so treated is used for drinking so most of the iodine is therefore lost. It is much more practical to use iodized salt. This latter method is becoming a more common practice and is certainly advisable as a preventive measure. McClendon predicts that with our increasing knowledge and widespread dissemination of the importance of iodine, there will be no problem of endemic goiter in the next generation.

At a future date I propose to publish the results of the analyses already made, and a further number to the extent of about 300 samples from other cities in the state.

NOTES ON OXIDATION OF CERTAIN METEORITES THE FORMATION OF METEORODES

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The question has frequently been asked by geologists, especially those interested in the study of meteorites: "What becomes of meteorites after they fall?" The fact that about 200,000 meteoris stones, most of which are known to have fallen within the last hundred years, have been found upon a rather small fraction of the earth's surface, leads one to wonder why we so seldom encounter meteorites in the late but prehistoric deposits of rock, and no authentic case has been recorded of a meteorite older than the Pleistocene. As Dr. Merrill has observed, "Further, and this seems the more singular when theories of earth history are considered, nothing that can with certainty be ascribed to a metoric origin has been found in terrestial beds of any geologic horizon but the most recent." In a footnote Dr. Merrill adds: "This fact was noted by Olbers nearly 90 years ago. Ward's statement as to the Pliocene age of the Lujan mesosiderite seems contradicted by its having been found in 'an undisturbed Quarternary formation'. If such have fallen during earlier periods, they must have been of a quite different type, or, what is more probable, become so thoroughly decomposed or otherwise altered as to be unrecognizable."

According to modern theories regarding the earth's history the falls of meteorites are less common now than they have been in the past. Why should not traces of meteorites be comparatively abundant in those layers of rock which by their structure clearly show that they were slowly accumulated in the bottoms of seas or lakes which furnish the most favorable situations for their preservation?

Frequently during recent years the question has arisen in the mind of the writer whether some of what we designate as "iron concretions", in sandstone, limestone, shale, and chalk, might not have had an extra-mundane origin in the form of meteorites which have now long since been oxidized, and have had leached from them their content of nickel by which we most often test the meteoric nature of suspected material.

The Brenham Meteorite,* from Kiowa County, Kansas, which was

*The Brenham shower of meteorites which probably fell prehistorically has been so well described that I need only briefly refer to a few facts. The liberal sprinkling of stones covered several square miles; and the individuals varied in size from a fraction of a gram to 211 Kgs. For the most part the individuals were typically pallasitic; but some few were entirely metallic and combined the siderite and pallasite characteristics.

Oxidized individuals have been reported from this fall nearly 40 years ago (see Amer. Jour. Sci., Ser. 3, 43:80; and Memoirs Natl. Acad. Sci.) 13:81) but the oxidized specimens herein discussed differ widely from any description previously recorded, and seem to represent a distinctive process of alteration.

discovered in 1885, and which during subsequent years has come to be so widely known for its generous supply of museum specimens, now promises to throw new light upon this interesting question. Upon a recent trip to the spot from which, through the years, these many specimens have been coming, the writer was fortunate in securing some oxidized fragments which illustrate very graphically the various successive stages in the transformation of this type of meteorite into what are commonly recognized as iron concretions. The Brenham meteorites belong principally to the class of pallasites. This type of meteorite consists of irregular bands of nickel-iron disposed in such a way as to form a spongy network, the cavities in which are filled with ovoid masses of olivine. This structure is illustrated in figure 1, taken from a photo of a polished slice of one of the individuals of this shower which has undergone but little oxidation.

The specimens which are the subject of this paper were taken from a "buffalo wallow" near the center of the area over which were scattered the many members of this famous fall. In the moist soil of this depression were found numerous fragmentary specimens, some of which are in a fair state of preservation, others of which are badly disintegrated, falling to pieces in a manner which has been all too well known to those experienced in the care of this type of meteorite for museum purposes. But still others when taken from the soil look not unlike ordinary iron concretions, some of them being almost spherical, others oblong, but for the most part characterized by the rounded projections or swellings so common in iron concretions and well illustrated in figure 2. Upon breaking these open, one is surprised to find in some of them nestled together, numerous olivine chondrules, which in surface appearance are exactly like those to be found by cutting the well-preserved pallasite stones, from this locality; but without the metallic bands between them which one sees in fresh specimens. (Figures 3, 4, 5.) In others one finds the process of disintegration gone farther and the chondrules already reduced to sand, or else so far advanced toward this condition that they readily crumble between the fingers. The outside of these meterodes, as I choose to call them ,consists of a compact wall of ferrite formed in more or less evident concentric lavers. The specific gravity of this crust indicates that it is principally limonite.

All men who have worked with them are well acquainted with the almost universal habit in iron meteorites of "sweating" iron chloride, known as lawrencite. This substance exudes from the specimens, carrying with it the dissolved metallic constituents to where they slowly solidify on the surface. Many specimens which have been in museums for years still exhibit this sweating.

In the specimens under consideration it is probable that this process has gone on until most of the metallic constituents have been carried to the surface and deposited in the form of oxides—principally limon-

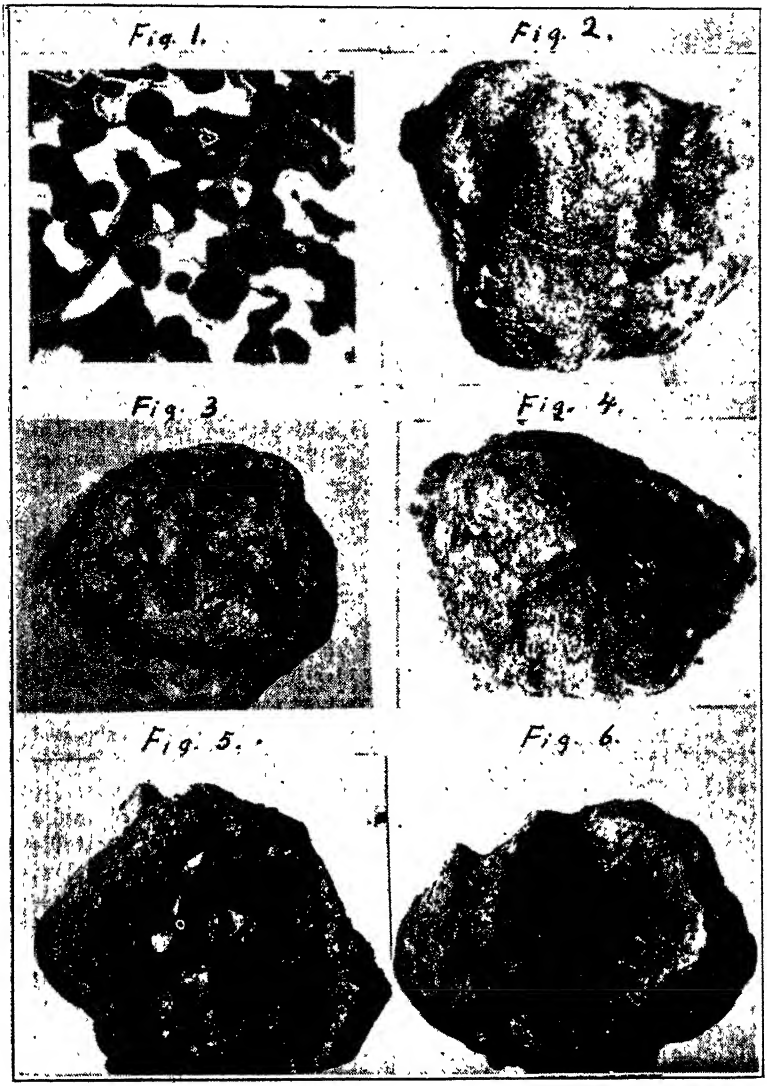

Fig. 1. Unoxidized polished slice of Brenham pallasite. The metallic portion shows white.

Fig. 2. External appearance of a meteorode.

Figs. 3, 4, 5. Meteorodes, broken open, showing contained olivine chondrules and open spaces left by migration of oxides to the surface.

Fig. 6. Meteorodes in which chondrules crumbled on exposure and were removed as sand.

ite. After the alteration of metals has been completed this oxide shell remains more or less stable, while the siliceous chondrules altering less rapidly, continue to break down under the action of moisture and temperature, until they are reduced to sand, so that the final product is a hollow ferrite nodule containing more or less sand; or perchance this sand may later consolidate along with such additional matter as may have been precipitated from the water which intermittently saturates the stone. This last condition is only conjectural since no example of it has been found at this writing.

We have here then proof positive that some of what have regarded by geologists as concretions have had their origin in meteorites. Most of our examples have evolved from meteorites of the pallasite variety; but some have almost certainly come from siderites. (It should be noted that the Brenham shower consisted for the most part, of pallasite individuals; but there were also a number of siderites and a few which exhibited a combination of pallasite and siderite characters.) These facts are the more significant since pallasites are a comparatively rare variety of meteorite, being only about one-twentieth as numerous among known meteorites as are irons. It would seem therefore, that the next logical step were to seek for definite criteria by which to identify with certainty the metamorphosed siderites, and, then, if possible, the stony meteorites, which among witnessed falls have been much more abundant than both the pallasites and siderites combined. If a satisfactory means of identifying nodules of meteoric origin can be arrived at it would seem to hold promises of much valuable information about the history of the earth. A comprehensive and detailed study of the petrographic and chemical aspects of ferrite nodules offers the most promise of a solution to this problem.

A determination for nickel in the limonite shell of these meteorodes yielded 1.47%. This, when compared with analyses of the metallic portion of the unaltered meteorites from Kiowa county is very low, showing a decided loss in nickel content through weathering. According to Eakin's analysis in 1890 the original metallic constituent of Brenham was composed of Fe 88.49% and Ni 10.37%. Winchell and Dodge in 1890 found Fe constituted 90.48% and Ni 8.59%. The nickel content found in our analysis if calculated on the metallic basis equals 2.46%. A comparison of the average results of analysis of fresh material with that of our oxidized crust is as follows:

Metallic			Oxidized		
Fe		Ni	Fe		Ni
89.48	:	9.47	37.13	:	2.46

A great loss of nickel is indicated by this analysis. If such a loss has taken place in the comparatively short residence of these specimens on the earth, it is not difficult to accept the idea of the complete removal of this metal in the course of a few thousand years, to say nothing of the great lapse of time since tertiary or older rocks were laid down. It seems quite certain, then, that a test for nickel would be useless in attempting to identify metamorphosed meteorites.

In conclusion the writer desires to emphasize the fact that in this paper no attempt is made to argue that even a considerable proportion of what are known as iron concretions have evolved from meteorites. From their structure it is evident that many of these bodies have been formed in other and divers manners, which need not be discussed in this paper. But certain it is, that the specimens here considered, and exhibited on this occasion, have evolved from meteorites.

The term **meteorodes** which has been introduced in this paper may be defined as a nodule of meteoric origin, consisting of an outer zone of ferrite enclosing the siliceous constituents of the original meteorite.

SUMMARY

1. It has long been a question why no trace of meteorites has been found in the various preglacial strata.
2. We have now found ferrite nodules which on their surface show no trace of their meteoric nature but upon internal examination reveal unmistakable evidence of such origin.
3. A series of these nodules graphically portrays the various successive steps by which a meteorite may metamorphose into a typical "iron concretion".
4. The term meteorode is introduced and the problem of distinguishing meteorodes from other concretionary nodules is presented for further investigation.

PLANTS THAT GROW IN ELLSWORTH COUNTY

CLEMENT WEBER

Clay Center, Kansas

Ellsworth County is located north of the central county of the state, having an area of 720 square miles and ranking high among the prosperous farming counties of the state. It was organized in 1867. The surface of the county is diversified and may be divided into "bottomland", "upland", or rolling plain and bluff land. The bottomland or valleys are from a quarter of a mile to a mile in width and aggregate about one-eighth of the entire area. The bluff land is found near the rivers and creeks while the south half of the county is nearly all undulating or prairie land.

The soil of the county is well adapted to grains and the most important crops are wheat and corn. However, oats, kafir corn and prairie hay are also extensively grown. The county ranks high in livestock raising and there are a good supply of fruit-bearing trees.

Magnesium limestone is abundant in the northeast section of the county and red sandstone in the central and southwestern parts. Mineral paint of a good quality and excellent potter's clay are found in many localities. Large quantities of gypsum exist in the high lands and in the central part are vast beds of rock salt which is extensively mined at Kanapolis.

Timber belts average about one-fourth of a mile in width and contain the following varieties: cottonwood, box-elder, ash, black walnut, elm, honey locust, and some specimens of mulberry.

The shrubs, plants and flowers which grow are varied, some are found in abundance and others are more rare. To the observant eye no lovelier sight can be presented than the wild flowers that deck the prairies when their varied colors blend and are wafted by the Kansas winds in streaming beauty. No cultivated garden can yield such a gorgeous display of color as these wild flowers do that are touched only by nature's cunning hand.

Having resided in Ellsworth County for many years, I decided to make a collection of the plants of Ellsworth County. Undoubtedly some plants escaped my observation whilst a few others could not be identified at this time, but I have the satisfaction of feeling that this list of 443 plants is the most complete list heretofore gathered. I have had three pleasant years, in my leisure moments, ferreting out, arranging and grouping these specimens in which Britton and Brown's Illustrated Flora of the Northern States and Canada was followed.

My unstinted thanks go to Professor F. C. Gates of the Kansas State Agricultural College, Manhattan, Kansas, for his untiring industry in cooperating with me. Much credit is due him for the invaluable part he played in its compilation.

Fam. Polypodiaceae

Woodsia obtusa Torr ————————Bluntlobed Woodsia
Pellaea atropurpurea Link. ————————Purple-stemmed Cliff-brake

Fam. Equisetaceae

Equisetum hyemale L.————————Common Scouring-rush
Equisetum laevigatum A. Br. ————————Smooth Scouring-rush

Fam. Pinaceae

Juniperus virginiana L.————————Red Cedar

Fam. Typhaceae

Typha latifolia L. ————————Broad-leaved Cat-tail

Fam. Alismaceae

Sagittaria brevirostra Mack. & Bush Short-beaked Arrow-leaf

Fam. Poaceae

Tripsacum dactyloides L. ————————Sesame-Grass
Andropogon furcatus Muhl. ————————Big Blue Stem
Sorghastrum nutans Nash ————————Indian-grass
Amphilophis saccharoides Neas ————————Torrey's Beard-grass
Holcus halepensis L. ————————Johnson-grass
Syntherisma sanguinale Dulac ————————Large Crab-grass
Echinochloa crus-galli Beauv. ————————Barnyard-grass
Panicum dichotomiflorum Michx. ————————Spreading Witch-grass
Panicum capillare L. ————————Witch-grass
Panicum virgatum L. ————————Switch-grass
Panicum scribnerianum Nash ————————Scribner's Panic-grass
Chaetochloa viridis Scribn. ————————Green Foxtail-grass
Chaetochloa glauca Scribn. ————————Yellow Foxtail
Cenchrus pauciflorus ————————Sandbur
Milium effusum L. ————————Tall Millet-grass
Aristida oligantha Michx. ————————Few-flowered Aristida
Muhlenbergia schreberi Gmel. ————————Nimble Will
Phleum pratense L. ————————Timothy
Bouteloua oligostachya Torr. ————————Grama-grass
Bouteloua curtipendula Torr. ————————Mesquite Grass
Bulbilis dactyloides Raf. ———————— Buffalo Grass
Munroa squarrosa Torr. ————————Munro's -grass
Eragrostis cilianensis ————————Strong-scented Love-grass
Eragrostis secundiflora Presl. ———————— Clustered Love-grass
Koeleria cristata Pers. ———————— Koeler's-grass
Poa compressa L. ————————. Wire grass
Poa buckleyana Nash ————————Buckley's Spear-grass
Bromus inermis Leyss ————————Hungarian Brome-grass
Bromus arvensis L. ———————— Field Brome
Agropyron smithii Rydb. ————————Western Wheat-grass
Hordeum pusillum Nutt. ————————Wild Barley
Hordeum jubatum L. ———————— Squirrel-tail Grass
Elymus canadensis L. ———————— Nodding Wild Rye
Elymus virginicus L. ————————Virginia Wild Rye

Fam. Cyperaceae

Cyperus houghtoni Torr. ————————Houghton's Cyperus

Cyperus esculentus L. ——————————Yellow Nut-grass
Cyperus filiculmis Vahl. ——————————Slender Cyperus
Eleocharis intermedia Schultes ———————Matted Spike-rush
Scirpus validus Vahl. ——————————American Great Bulrush
Scirpus fluviatilis A. Gray ——————————River Bulrush
Scirpus lineatus Michx. ——————————Reddish Bulrush
Carex normalis Mackenzie ——————————Larger Straw Sedge
Carex stricta Lam. ——————————Tussock Sedge
Carex hystricina Muhl. ——————————Porcupine Sedge

Fam. Araceae

Arisaema dracontium Schott ————————Green Dragon

Fam. Commelinaceae

Commelina virginica L. ——————————Virginia Day-flower
Tradescantia virginiana L. —————————— Spiderwort

Fam. Juncaceae

Juncus tenuis Willd. ——————————Slender Rush
Juncus torreyi Coville ——————————Torrey's Rush

Fam. Liliaceae

Allium mutabile Michx. ——————————Wild Onion
Allium nuttalli S. Wats. ——————————Nuttall's Wild Onion
Androstephium coeruleum Greene ————Androstephium
Yucca glauca Nutt. ——————————Soap-weed
Asparagus officinalis L. —————————— Asparagus
Vagnera stellata Morong ——————————Star-flowered Solomon's Seal
Smilax hispida Muhl. ——————————Hispid Greenbrier

Fam. Juglandaceae

Juglans nigra L. ——————————Black Walnut

Fam. Salicaceae

Populus deltoides Marsh. ——————————Cottonwood
Salix amygdaloides Anders ——————————Peach-leaved Willow
Salix longifolia Muhl. ——————————Sandbar Willow

Fam. Fagaceae

Quercus macrocarpa Michx. —————————— Bur Oak

Fam. Ulmaceae

Ulmus americana L. ——————————American White Elm
Ulmus fulva Michx. ——————————Red Elm
Celtis occidentalis L. ——————————Hackberry

Fam. Moraceae

Morus rubra L. ——————————Red Mulberry
Toxylon pomiferum Raf. ——————————Osage Orange

Fam. Urticaceae

Urtica gracilis Ait. ——————————Slender Wild Nettle
Boehmeria cylindrica Sw. ——————————False Nettle
Parietaria pennsylvanica Muhl. ——————Pennsylvania Pellitory

Fam. Santalaceae

Comandra pallida A. DC. ——————————Pale Comandra

Fam. Polygonaceae

Eriogonum jamesii Benth. ——————————James' Eriogonum
Rumex altissimus Wood ——————————Tall Dock
Rumex occidentalis S. Wats. ————————Western Dock

Rumex crispus L.	Curled or Narrow Dock
Rumex obtusifolius L.	Broad-Leaved Dock
Polygonum aviculare L.	Pink-weed
Polygonum ramosissimum Michx.	Bushy Knotweed
Polygonum tenue Michx.	Slender Knotweed
Persicaria muhlenbergii Small	Swamp Persicaria
Persicaria lapathifolia S. F. Gray	Dock-leaved Persicaria
Persicaria pennsylvanica Small	Pennsylvania Persicaria
Persicaria punctata Small	Water Smart-weed
Tiniaria convolvulus Webb & Moq.	Black Bindweed
Tiniaria scandens Small	Climbing False Buckwheat

Fam. Amaranthaceae

Amaranthus retroflexus L.	Red Root
Amaranthus hybridus L.	Pilewort
Amaranthus blitoides S. Wats.	Prostrate Amaranth
Amaranthus graecizans L.	Tumbleweed
Amaranthus torreyi Benth.	Torrey's Amaranth
Amaranthus caudatus L.	Love-Lies Bleeding
Amaranthus hypochondriacus Bailey	Princes-Feather
Froelichia campestris Small	Prairie Froelichia

Fam Chenopodiaceae

Chenopodium album L.	Lamb's Quarters
Chenopodium hybridum L.	Maple-leaved Goosefoot
Cycloloma atriplicifolium Coult.	Winged Pigweed
Kochia scoparia Roth.	Kochia
Monolepis nuttalliana Greene	Monolepis
Salsola pestifer A. Nelson	Russian Thistle

Fam. Phytolaccaceae

Phytolacca americana L.	Pokeweed

Fam. Corrigiolaceae

Paronychia wardii Ryd.	Ward's Whitlow-wort

Fam. Nyctaginaceae

Allionia linearis Pursh.	Narrow-leaved Umbrella-wort
Allionia hirsuta Pursh.	Hairy Umbrella-wort
Allionia nyctaginea Michx.	Heart-leaved Umbrella-wort

Fam. Aizoaceae

Mollugo verticillata L.	Carpet-weed

Fam. Portulacaceae

Talinum calycinum Engelm.	Large-flowered Talinum
Claytonia virginica L.	Spring Beauty
Portulaca oleracea L.	Purslane

Fam. Caryophyllaceae

Alsine media L.	Common Chickweed
Cerastium semidecandrum L.	Small Mouse-ear Chickweed
Cerastium vulgatum L.	Larger Mouse-ear Chickweed
Cerastium brachypodum Robinson	Short-stalked Chickweed
Arenaria texana Britton	Texas Sandwort
Silene antirrhina L.	Sleepy Catchfly

Silene noctiflora L. ---------------- Night-flowering Catchfly
Saponaria officinalis L. ------------- Bouncing Bet
Vaccaria vaccaria Britton ---------- Cow Cockle

Fam. Ranunculaceae

Delphinium ajacis L. --------------- Rocket Larkspur
Delphinium virescens Nutt. --------- Prairie Larkspur
Anemone caroliniana Walt. --------- Carolina Anemone
Ranunculus delphinifolius Torr. ----- Yellow Water-Crowfoot
Ranunculus sceleratus L. ----------- Celery-leaved Crowfoot
Thalictrum dasycarpum Fisch. & Lall. Tall Meadow-Rue
Clematis fremonti Wats. ----------- Fremont's Bower

Fam. Menispermaceae

Menispermum canadense L. --------- Canada Moonseed

Fam. Papaveraceae

Argemone alba Lestib. ------------ White Prickly Poppy
Capnoides campestre Britton ------- Plains Corydalis

Fam. Brassicaceae

Draba caroliniana Walt. ------------ Carolina Whitlow-grass
Camelina sativa Crantz ------------ Gold-of-Pleasure
Bursa bursa-pastoris Britton ------- Shepherd's Purse
Radicula sinuata Greene ----------- Spreading Yellow-cress
Sisymbrium nasturtium-aquaticum L.-- True Water-cress
Lepidium virginicum L. ------------ Wild Pepper-grass
Carara didyma Britton ------------ Lesser Wart-cress
Sophia incisa Greene -------------- Western Tansy-Mustard
Sophia hartwegiana Greene ------ Hartweg's Tansy Mustarc
Cheirinia aspera Britton ----------- Western Wall-flower
Erysimum officinale L. Scop. ------- Hedge Mustard
Norta altissima Britton ------------ Tall Sisymbrium
Conringia orientalis Dumort. ------- Hare's-ear Mustard
Sinapis alba L. ------------------- White Mustard
Sinapis arvensis L. ---------------- Wild Mustard
Brassica campestris L. ------------ Turnip
Brassica juncea Cosson. ----------- Indian Mustard

Fam. Capparidaceae

Cleome serrulata Pursh. --------- Pink Cleome
Polanisia trachysperma T. & G. -- Large-flowered Clammy-w

Fam. Grossulariaceae

Ribes americanum Mill. ------------ Wild Black Currant
Grossularia setosa Cov. & Britt. ---- Bristly Gooseberry

Fam. Rosaceae

Potentilla monspeliensis L. --------- Rough Cinquefoil
Geum canadense Jacq. ------------- White Avens
Rosa pratincola Greene ------------ Arkansas Rose

Fam. Prunaceae

Prunus americana Marsh ----------- Wild Yellow or Red Plum
Prunus angustifolia Marsh --------- Chickasaw Plum
Prunus virginiana L. -------------- Choke Cherry
Prunus gracilis Engelm. ----------- Low Plum

Fam. Mimosaceae

Acuan illinoensis Kuntze ----------Illinois Mimosa
Morongia uncinata Britton ---------Sensitive-brier

Fam. Cassiaceae

Cassia marilandica L. --------------Wild Senna
Cassia medsgeri Shafer -----------Medsger's Wild Senna
Gleditsia triacanthos L. -----------Honey Locust
Gymnocladus dioica Koch. ---------Coffee Tree

Fam. Fabaceae

Baptisia australis R. Br. -----------Blue False Indigo
Medicago sativa L. ----------------Alfalfa
Medicago lupulina L. ---------------Black Medic
Melilotus alba Desv. --------------- White Sweet-clover
Melilotus officinalis Lam. ----------Yellow Sweet-clover
Trifolium pratense L. --------------Red Clover
Trifolium repens L. ----------------White Clover
Hosackia americana Piper ----------Prairie Bird's-foot Trefoil
Psoralea tenuiflora Pursh. ----------Few-flowered Psoralea
Psoralea argophylla Pursh. ---------Silver-leaf Psoralea
Psoralea cuspidata Pursh. ---------- Large-bracted Psoralea
Psoralea esculenta Pursh. -----------Indian Bread-root
Amorpha fruticosa L. ---------------False Indigo
Amorpha canescens Pursh. ---------Lead-plant
Parosela enneandra Britton ---------Slender Parosela
Parosela aurea Britton -------------Golden Parosela
Petalostemum oligophyllum Torr. ---Slender White Prairie-clover
Petalostemum tenuifolium A. Gray .Silky Prairie-clover
Petalostemum villosum Nutt. -------Hairy Prairie-clover
Geoprumnon mexicanum Rybd. ------Larger Ground Plum
Geoprumnon plattense Rydb. -------Platte Milk Vetch
Astragalus drummondii Dougl. -----Drummond's Milk Vetch
Astragalus missouriensis Nutt. ---Missouri Milk Vetch
Astragalus gracilis Nutt. ---------Slender Milk Vetch
Oxytropis lamberti Pursh. ----------Stemless Loco-weed
Glycyrrhiza lepidota Pursh. ---------Wild Licorice
Lespedeza capitata Michx. ----------Round-headed Bush Clover
Vicia truncata Nutt. ----------------American Vetch
Strophostyles pauciflora S. Wats. ---Small Wild Bean
Glycine apios L. -------------------Ground-nut
Robinia pseudo-acacia L. ---------- Black locust

Fam. Geraniaceae

Geranium carolinianum L. ----------Carolina Crane's-bill

Fam. Oxalidaceae

Ionoxalis violacea Small ------------Violet Wood Sorrel
Xanthoxalis stricta Small -----------Upright Yellow Wood-sorrel

Fam. Linaceae

Cathartolinum sulcatum Small ------Grooved Yellow Flax

Fam. Zygophyllaceae

Tribulus terrestris L. --------------Ground Burnut

Fam. Simarubaceae

Ailanthus altissima Swingle --------Tree-of-Heaven

Fam. Polygalaceae

Polygala alba Nutt. --------------- White Milkwort

Fam. Euphorbiaceae

Croton monanthogynus Michx. ------Single-fruited Croton
Croton texensis Muell. Arg. ---------Texas Croton
Acalypha ostryaefolia Ridd ---------Horn-beam 3-seeded Mercury
Acalypha virginica L. -------------Virginia Three-seeded Mercury
Chamaesyce serpens Small ----------Spreading Spurge
Chamaesyce maculata Small --------Spotted Spurge
Chamaesyce preslii Arthur ---------Large Spotted Spurge
Zygophyllidium hexagonum Small --Angled Spurge
Dichrophyllum marginatum Kl. & Garcke Snow-on-the-mountain
Tithymalus helioscopia Hill ---------Sun Spurge
Tithymalus cyparissias Hill ---------Cypress Spurge
Poinsettia dentata Small -----------Toothed Spurge
Poinsettia heterophylla Kl. & Garcke Various-leaved Spurge

Fam. Anacardiaceae

Rhus glabra L. --------------------Scarlet Sumac
Schmaltzia trilobata Small ---------Ill-scented Sumac
Toxicodendron radicans Kuntze --- Poison Ivy

Fam. Celastraceae

Euonymus atropurpureus Lacq. -----Burning Bush
Celastrus scandens L. --------------Climbing Bittersweet

Fam. Aceraceae

Acer negundo L. --------------------Boxelder

Fam. Rhamnaceae

Ceanothus ovatus Desf. -------------Smaller Red-root

Fam. Vitaceae

Vitis vulpina L. ---------------------Riverside Grape
Parthenocissus quinquefolia Planch. Virginia Creeper

Fam. Tiliaceae

Tilia glabre Vent. -----------------Basswood

Fam. Malvaceae

Callirhoe digitata Nutt. ----------Fringed Poppy-Mallow
Malva rotundifolia L. --------------Dwarf Mallow
Callirhoe involucrata A. Gray -------Purple Poppy-Mallow
Malvastrum coccineum A. Gray -----Red False Mallow
Abutilon abutilon Rusby ------------Indian Mallow
Hibiscus trionum L. ----------------Bladder Ketmia

Fam. Violaceae

Viola papilionacea Pursh. -----------Hooded Blue Violet
Viola pedatifida Don. ---- ----------Larkspur Violet
Viola odorata L. ------------------ Sweet Violet
Viola rafinesquii Greene ------------Field Pansy

Fam. Loasaceae

Mentzelia oligosperma Nutt. --------Few-seeded Mentzelia
Nuttallia decapetala Greene --------Prairie-lily

Fam. Cactaceae

Coryphantha vivipara Britton & Rose Purple Cactus
Opuntia humifusa Raf. ------------Western Prickly Pear

Fam. Lythraceae

Ammannia koehnei Britton ---------Koehne's Ammannia
Lythrum alatum Pursh. ------------Wing-angled Loosestrife

Fam. Oenotheraceae

Isnardia palustris L. ---------------Marsh Purslane
Jussiaea diffusa Forskal. -----------Floating Primrose-willow
Epilobium lineare Muhl. ------------Linear-leaved Willow-herb
Epilobium coloratum Muhl. ---------Purple-leaved Willow-herb
Oenothera biennis L. ---------------Common Evening-Primrose
Raimannia laciniata Rose ----------Cut-leaved Evening-Primrose
Raimannia grandis Rose -------Large-flowered Cut-leaved E-Primrose
Hartmannia speciosa Small ---------Showy Evening Primrose
Megapterium fremontii Britton -----Fremont's Primrose
Meriolix serrulata Walp. -----------Tooth-leaved Primrose
Gaura parviflora Dougl. ------------Small-flowered Gaura
Gaura coccinea Pursh. --------------Scarlet Gaura
Stenosiphon linifolium Britton ------Flax-leaved Stenosiphon

Fam. Haloragidaceae

Myriophyllum heterophyllum Michx. Water-Milfoil

Fam. Ammiaceae

Sanicula canadensis L. -------------Snakeroot
Daucus pusillus Michx. ------------American Wild Carrot
Chaerophyllum teinturieri Hook ----Teinturier's Chervil
Cogswellia daucifolia M. E. Jones ---Carrot-leaved Parsley
Conium maculatum L. --------------Poison Hemlock
Berula erecta Coville ---------------Cut-leaved Water Parsnip
Ptilimnium capillaceum Raf. -------Mock Bishop-weed

Fam. Cornaceae

Cornus asperifolia Michx. ----------Rough-leaved Dogwood

Fam. Primulaceae

Androsace occidentalis Pursh. ------Androsace
Lysimachia nummularia L. --------Money-wort
Steironema ciliatum Raf. -----------Fringed Loosestrife
Anagallis arvensis L. --------------Red Pimpernel

Fam. Oleaceae

Fraxinus americana L. -------------White Ash

Fam. Apocynaceae

Apocynum medium Greene ----------Intermediate Dogbane
Apocynum cannabinum L. ----------Indian Hemp

Fam. Asclepiadaceae

Asclepias tuberosa L. --------------Butterfly-weed
Asclepias incarnata L. -------------Swamp Milk-weed
Asclepias speciosa Torr ------------Showy Milk-weed
Asclepias pumila Vail. -------------Low Milkweed
Asclepias verticillata L. ------------Whorled Milkweed
Asclepiodora viridis A. Gray --------Oblong-leaved Milkweed

Acerates viridiflora Eaton ---------- Green Milkweed
Acerates angustifolia Dec. ----------Narrow-leaved Milkweed

Fam. Convolvulaceae

Evolvulus pilosus Nutt. ------------Evolvulus
Ipomoea purpurea Lam. ------------Morning Glory
Ipomoea leptophylla Torr. ----------Bush Morning Glory
Convolvulus sepium L. ------------Hedge Bindweed
Convolvulus arvensis L. ------------Small Bindweed

Fam. Polemoniaceae

Phlox divaricata L. ---------------Wild Blue Phlox

Fam. Hydrophyllaceae

Nyctelea nyctelea Britton ----------Nyctelea

Fam. Boraginaceae

Lappula lappula Karst. ------------Blue Burseed
Lappula texana Britton ------------Hairy Stickseed
Mertensia virginica DC. ------------Virginia Cowslip
Lithospermum carolinense MacM. ---Gmelin's Puccoon
Lithospermum linearifolium Goldie --Narrow-leaved Puccoon
Onosmodium molle Michx. ----------Soft-hairy False Cromwell

Fam. Verbenaceae

Verbena urticifolia L. --------------Nettle-leaved Vervain
Verbena hastata L. ----------------False Vervain
Verbena stricta Vent. --------------Hoary Vervain
Verbena bracteosa Michx. ----------Large-bracted Vervain
Verbena bipinnatifida Nutt ---------Small-flowered Verbena
Lippia cuneifolia Steud. ------------Wedge-leaved Fog-fruit

Fam. Lamiaceae

Teucrium canadense L. -------------American Germander
Scutellaria lateriflora L. ------------Blue Skullcap
Scutellaria brittonii Porter ---------Britton's Skullcap
Marrubium vulgare L. -------------Common Hoarhound
Nepeta cataria L. ------------------Catmint
Glecoma hederacea L. --------------Ground Ivy
Lamium amplexicaule L. -----------Henbit
Salvia pitcheri Torr. ---------------Tall Sage
Salvia lanceifolia Poir. -------------Lance-leaved Sage
Monarda fistulosa L. ---------------Wild Bergamot
Monarda pectinata Nutt. -----------Plains Lemon Monarda
Hedeoma hispida Pursh. ------------Rough Pennyroyal
Hedeoma longiflora Rydb. ----------Long-flowered Pennyroyal
Lycopus americana Muhl. ----------Cut-leaved Water Hoarhound
Mentha spicata L. -----------------Spearmint
Mentha piperita L. ----------------Peppermint
Perilla frutescens Britton -----------Perilla

Fam. Solanaceae

Physalis virginiana Mill ------------Virginia Ground-Cherry
Physalis heterophylla Nees. ---------Clammy Ground-Cherry
Solanum nigrum L. ----------------Black Nightshade

Solanum carolinense L.	Horse-Nettle
Solanum elaeagnifolium Cav.	Silver-leaved Nightshade
Solanum rostratum Dunal.	Buffalo Bur
Lycium halimifolium Mill.	Matrimony Vine
Datura stramonium L.	Jimson-weed
Datura metel L.	Entire-leaved Thorn-Apple
Fam. Scrophulariaceae	
Verbascum thapsus L.	Great Mullen
Linaria linaria Karst.	Butter-and-Eggs
Pentstemon albidus Nutt.	White-flowered Beard-tongue
Pentstemon cobaea Nutt.	Cobaea Beard-tongue
Mimulus geyeri Torr.	Monkey Flower
Conobea multifida Benth.	Conobea
Veronica peregrina L.	Purslane Speedwell
Veronica arvensis L.	Corn Speedwell
Digitalis purpurea L.	Purple Fox Glove
Agalinis aspera Britton	Rough Purple Agalinis
Fam. Bignoniaceae	
Bignonia radicans L.	Trumpet-creeper
Catalpa speciosa Warder	Catalpa
Fam. Martyniaceae	
Martynia louisiana Mill.	Unicorn-Plant
Fam. Phrymaceae	
Phryma leptostachya L.	Lopseed
Fam. Plantaginaceae	
Plantago major L.	Common Plantain
Plantago lanceolata L.	Ribwort
Plantago purshii R & S.	Pursh's Plantain
Plantago virginica L.	Dwarf Plantain
Fam. Rubiaceae	
Houstonia angustifolia Michx.	Narrow-leaved Houstonia
Cephalanthus occidentalis L.	Button-bush
Galium aparine L.	Bed-straw
Sherardia arvensis L.	Blue Field Madder
Fam. Caprifoliaceae	
Sambucus canadensis L.	American Elder
Symphoricarpos symphoricarpos McM.	Coral-berry
Fam. Cucurbitaceae	
Pepo foetidissima Britton	Calabazilla
Fam. Campanulaceae	
Specularia perfoliata A. DC.	Venus' Looking-glass
Specularia leptocarpa A. Gray	Western Venus' Looking-glass
Lobelia cardinalis L.	Cardinal-flower
Lobelia syphilitica L.	Great Blue Lobelia
Fam. "Compositae"	
Cichorium intybus L.	Chicory
Tragopogon pratensis L.	Yellow Meadow Salsify
Tragopogon porrifolius L.	Oyster Plant
Leontodon taraxacum L.	Dandelion

Sonchus oleraceus L. ---------------Annual Sow-Thistle
Sonchus asper Hill -----------------Spiny Sow-Thistle
Lactuca canadensis L. -------------Wild Lettuce
Lactuca sagittifolia Ell. ------------Arrow-leaved Lettuce
Lactuca pulchella DC. --------------Blue Lettuce
Lygodesmia juncea D. Don. ---------Rush-like Lygodesmia
Agoseris cuspidata D. Dietr. --------Prairie False Dandelion
Sitilias grandiflora Greene ----------False Dandelion
Iva ciliata Willd. -------------------Rough Marsh Elder
Iva xanthiifolia Nutt. ---------------Burweed Marsh Elder
Ambrosia trifida L. -----------------Great Ragweed
Ambrosia elatior L. ---------------- Annual Ragweed
Ambrosia psilostachya DC. ---------Western Ragweed
Xanthium pennsylvanicum Wallr. ---Cockle-bur
Vernonia baldwinii Torr. -----------Baldwin's Iron-weed
Eupatorium perfoliatum L. ---------Common Thoroughwort
Kuhnia eupatorioides L. ------------False Boneset
Lacinaria punctata Kuntze ---------Blazing Star
Gutierrezia sarothrae Brit. & Rusby Broom-weed
Grindelia lanceolata Nutt. ----------Gum-plant
Chrysopsis villosa Nutt. ------------Hairy Golden Aster
Chrysopsis stenophylla Greene ------Stiff-leaved Golden Aster
Prionopsis ciliata Nutt. -------------Prionopsis
Sideranthus spinulosus Sweet ------Cut-leaved Sideranthus
Isopappus divaricatus T. & G. ------Isopappus
Solidago serotina Ait. ---------------Late Golden-rod
Solidago glaberrima Martens -------Missouri Golden-rod
Solidago altissima L. ---------------Tall Golden-rod
Solidago mollis Martl. ---------------Ground Golden-rod
Solidago rigida L. ------------------Stiff Golden-rod
Townsendia exscapa Porter --------Low Townsendia
Aster oblongifolius Nutt. -----------Aromatic Aster
Aster sericeus Vent. ----------------Silky Aster
Aster multiflorus Ait. ---------------White Wreath Aster
Aster paniculatus Lam. -------------Panicled Aster
Machaeranthera tanacetifolia Nees.--Tansy Aster
Erigeron ramosus B. S. P. ----------Daisy Fleabane
Leptilon canadense Britton --------Horse-weed
Leptilon divaricatum Raf. -----------Low Horse-weed
Filago prolifera Britton ------------Filago
Antennaria canadensis Greene ------Canadian Cat's-foot
Antennaria campestris Rydberg ----Prairie Cat's-foot
Silphium integrifolium Michx. ------Entire-leaved Rosin-wood
Silphium laciniatum L. -------------Compass-plant
Rudbeckia triloba L. ---------------Thin-leaved Cone-flower
Ratibida columnaris D. Don. -------Prairie Cone-flower
Ratibida tagetes Barnhart --------Short-rayed Cone-flower

Echinacea pallida Britton	Purple Cone-flower
Helianthus annua L.	Common Sunflower
Helianthus petiolaris Nutt.	Prairie Sunflower
Helianthus scaberrimus Ell.	Stiff Sunflower
Helianthus maximiliani Schrad.	Maximilian's Sunflower
Helianthus subrhomboideus Rydb.	Rhombic-leaved Sunflower
Helianthus tuberosus L.	Jerusalem Artichoke
Coreopsis tinctoria Nutt.	Golden Coreopsis
Bidens laevis B. S. P.	Smooth Bur-Marigold
Bidens connata Muhl.	Swamp Beggar-ticks
Bidens frondosa L.	Beggar-ticks
Thelesperma gracile A. Gray	Rayless Thelesperma
Hymenopappus corymbosus T. & G.	White Hymenopappus
Tetraneuris stenophylla Rydb.	Narrow-leaved Tetraneuris
Gaillardia pulchella Foug.	Blanket Flower
Boebera papposa Rydb.	Fetid Marigold
Pectis augustifolia Torr.	Lemon-scented Pectis
Achillea millefolium L.	Yarrow
Anthemis tinctoria L.	Yellow Camomile
Chrysanthemum balsamita L.	Cost-mary
Matricaria inodora L.	Mayweed
Matricaria Chamomilla	German Camomile
Tanacetum vulgare L.	Tansy
Artemisia filifolia Torr.	Silvery Wormwood
Artemisia absinthium L.	Common Wormwood
Artemisia annua L.	Annual Wormwood
Artemisia vulgaris L.	Common Mugwort
Artemisia ludoviciana Nutt.	Dark-leaved Mugwort
Artemisia mexicana Willd.	Mexican Mugwort
Artemisia gnaphalodes Nutt.	Western Sage
Senecio vulgaris L.	Common Groundsel
Senecio pauperculus Michx.	Balsam Groundsel
Senecio tomentosus Michx.	Woolly Ragweed
Arctium minus Schk.	Common Burdock
Cirsium altissimum Spreng.	Tall Thistle
Cirsium undulatum Spreng	Wavy-leaved Thistle
Cirsium ochrocentrum A. Gray	Yellow-spined Thistle
Cirsium odoratum Britton	Fragrant Thistle

AEGILOPS CYLINDRICA HOST., A WHEAT-FIELD WEED IN KANSAS[1]

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In August, 1917, specimens of the seed of an unidentified plant were sent to the seed laboratory of the Kansas Agricultural Experiment Station by Mr. L. L. Anderson of Trousdale, Edwards County, Kansas. No further specimens were received until 1920 when a farmer in the same locality sent seed to the state seed laboratory for identification. These early collections were all merely specimens of the seed which had been found in threshed wheat and the identity of the plant which produced such seed was unknown. Nothing could be found in American botanical literature that described seed of that nature. Plants bearing spikes or parts of spikes were collected in 1921, however, and the plant was identified as Aegilops cylindrica Host. by the use of European descriptions, no description of it being available in American literature at that time. Mayfield[2] prepared a preliminary report on the occurence of the grass in Kansas from data supplied by the authors. More recently Kennedy[3] has described another species, Ae. triuncialis L. occurring as a weed in California.

This plant is a grass very similar to wheat in appearance and is a rather common weed in cultivated land around the Mediterranean Sea. It is one of the most common weeds in wheat fields of southern Russia bordering the Black and Caspian Seas. In that area several other species of the same genus are also fairly common, notably Ae. triuncialis L., Ae. crassa Boiss., and Ae. ovata L. These together with Ae. cylindrica are indegenous to southeastern Europe and are known by several common names. Dr. Otto Stapf of the New Botanical Gardens kindly informed the authors that goat grass seems to be the name which has been most widely used in Europe for Ae. cylindrica and that name has been adopted and used in correspondence relative to the grass in Kansas.

From 1921 to 1926 many specimens of this weed were received from county agents, farmers, grain dealers, millers, and others interested in the wheat industry in Kansas and Oklahoma. Many correspondents were becoming alarmed at the increasing proportion of the grass found in wheat fields in certain localities and information on

1. Contribution No. 294 from the Department of Botany and Plant Pathology and No. 135 from the Department of Agronomy, Kansas State Agricultural College.

2. Mayfield, Lyle. Goat grass—a weed pest of central Kansas wheat fields. The Kansas Agricultural Student 7:40-41. 1927.

3. Kennedy, P. B. Goat grass or Wild Wheat (Aegilops triuncialis). Jour. Amer. Soc. Agron. 20:1292-1296. 1928.

methods of eradication were eagerly sought. The authors, therefore visited infested areas, studied the plant in the field and reviewed the literature concerning it. Considerable valuable information on the characters, distribution, and severity of the pest has resulted from these studies. At the present time it is still found in abundance in certain counties of central Kansas, but seems to be spreading to other areas only very slowly.

Botanically, goat grass is very closely related to cultivated wheat, being placed in the genus Triticum by some leading American and European systematic botanists. However, the genus name Aegilops has been generally adopted and widely used in the literature of recent years. The relationship between goat grass and wheat is reflected in the ease with which they may be crossed, and the amount of natural crossing which occurs in the field. It is not particularly difficult to make successful crosses between goat grass and wheat under controlled conditions, but the plants arising from such crosses are nearly always sterile.

Natural crossing between wheat and goat grass occurs to a limited extent in the fields in Kansas. The amount of such crossing apparently depends considerably on the season, there being many hybrid plants in some seasons and very few in others. The F_1 plants are easily distinguished in the field by their greater height and spikes intermediate in size, shape and awnedness between those of wheat and goat grass. Such plants show marked hybrid vigor, often being as tall or taller than the surrounding wheat. The spikes of hybrid plants, having Turkey type wheat as one parent, are intermediate between those of wheat and goat grass, being awned like wheat but more compact and cylindrical in shape like Aegilops.

In the early stages of growth goat grass resembles winter wheat very closely and a critical examination of the plant is necessary to identify it in fields of wheat. The grass is a winter annual like wheat, emerging early in the fall, making a spreading growth and maturing the following summer at about the same time as wheat.

In vegetative characters the young plants of goat grass are very similar to winter wheat except that the coleoptiles are a deeper purple in color and the seedlings somewhat more slender. The leaves are shorter than wheat leaves and bear cilia on the edges near the base, while wheat leaves lack cilia. It usually tillers more profusely than wheat, as many as fifty stems frequently being found on a single plant. In fields where there is a large proportion of the grass much wheat is therefore crowded out by it. In spots where there is a thick stand very few wheat plants are found and those usually have only a few small heads, showing their inability to compete with the vigorous growing and prolific tillering Aegilops. The weed is also very winter hardy and in seasons in which winter killing occurs in the wheat goat grass often shows no injury. In such seasons infested fields may show a greater percentage of grass in the spring than was apparent in the fall.

When the grass comes into head the plants easily can be distinguished from wheat. The spikes are very slender and cylindrical, the spikelets being sunken in the hollowed-out internodes of the rachis. The glumes are much appressed and nearly awnless, the spikelets at the apex being the only ones to bear long awns.

Two varieties of goat grass are found in Kansas, one having pubescent outer glumes, while in the other the outer glumes are scabrous. The scabrous variety is more frequently found in Kansas than the pubescent one, however. In both varieties the outer glumes are reddish brown at the time of mateurity.

The stems of the mature plants are much shorter and more slender than those of wheat. The plants usually average 16-24 inches in height, or about one-half that of wheat. The straw is rather weak, often allowing the spikes to extend away from the crown of the plant in all directions, but many spikes are also borne upright. The peduncles at the time of maturity become purplish in color, a character which aides materially in locating Aegilops plants in fields of yellow-strawed wheat.

At maturity the spikes of goat grass disarticulate at each node of the rachis allowing entire spikelets to fall to the ground. So complete is this disarticulation, that the spikelets fall away at the slightest touch, the seed being scattered in all directions by such agents as wind, animals, machinery, and man. The apical spikelets mature first and ripening progresses down the spike toward the base, the spikelets frequently falling to the ground as soon as mature. It is thus impossible to collect mature plants bearing complete spikes. Most herbarium specimens therefore are immature plants and often do not show the characteristic coloring of stems and glumes. Goat grass usually matures a few days earlier than winter wheat and much of the seed has therefore been shed before harvest time. Plants which have not already shed their seed are usually dead ripe when the grain is cut and the spikelets are scattered in all directions by the harvesting machinery. Most of the seed falls to the ground but a considerable quantity of it also gets into the threshed grain. We therefore have, besides the natural dissemination by the plant and artificial dissemination by animals and machinery, considerable dissemination through the sowing of wheat containing goat grass seed. Such contaminations are extremely difficult to remove from wheat since the spikelets are of about the same weight as well formed grains of wheat, although they usually are slightly larger.

It has already been stated that the entire spikelets were shed at maturity. Each spikelet consists of a pair of outer glumes which closely enclose 3 to 5 florets, all of which fit snugly into the side of a large concavity in the attached internode of the rachis. The entire spikelet is thus cylindrical in shape and has often been mistaken for small pieces of straw in threshed wheat. Of the 3 to 5 florets usually found within the outer glumes, the first two are usually the

only ones which bear seed. The caryopsis resembles that of wheat in shape and texture, but differs in that the lemma and palet adhere to it in the goat grass.

The origin of goat grass in Kansas presents an interesting problem. It is certain that the plant is not indigenous to North America. It is known to be native in southeastern Europe and particularly in that part of Russia from which the Turkey type wheats were brought to the United States. Much Turkey wheat was brought to Kansas by Russian Mennonite immigrants who settled in McPherson and Harvey Counties in 1873. At about the same time many Russian Catholics settled in Barton, Ellis and Pawnee Counties. They also brought seed of Turkey wheat with them from Russia. It is interesting to note that goat grass is most widely distributed in Barton and Pawnee Counties and in counties directly southward and eastward. It therefore seems likely that the grass was brought to Kansas by these early settlers. This is by no means certain, however, since several other importations of Turkey type wheats are known to have been made. The United States Department of Agriculture imported a considerable quantity of Kharkof wheat from Russia in 1900 and distributed it to farmers in central and western Kansas. This seed may have contained goat grass. In any event, it is interesting to note the long period of time required for the grass to become sufficiently abundant to attract attention.

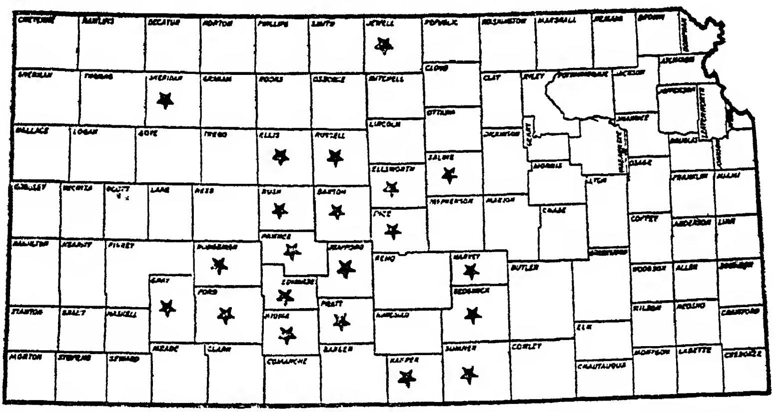

Figure 1. Kansas Counties in which Goat Grass (Aegilops cylindrica) has been collected or reported in wheat fields.

It is not possible to make an accurate estimate of the total distribution and the number of infested acres in Kansas at the present time. Reports of its occurence have been received from 22 counties in central Kansas with the heaviest infestations in Kiowa, Edwards, Pawnee, Barton and Rice Counties. See Fig. 1. It is certain that many thousands of acres in this area are infested with the grass, but the severity varies greatly with the locality. In some com-

munities only occasional plants are found scattered through the fields while in certain parts of the badly infested counties fields are often found which contain large percentages of the weed. Fields have been visited which contained spots of 5 to 35 acres which were solid stands of goat grass.

No experiments have been conducted on methods of control of this weed, but farmers in infested areas have worked out efficient means of combating it. The problem is somewhat simplified by the fact that the plant is a winter annual and therefore can be killed by cultivation. The grass is common not only in the wheat fields proper, but considerable quantities of it have been seen in fence rows, waste land, and on roadsides where the soil has been broken or disturbed by animals or implements. It does not seem to be able to establish itself and compete with native grasses in pastures or meadows. It is apparently essentially a cultivated or waste-land weed. Although cultivation readily destroys the grass in the fields proper, the plants growing in fence rows and disturbed roadsides serve as a constant source of fresh infestation. Where wheat is grown continuously goat grass has been very difficult to eradicate due to the extreme ease with which it reseeds itself. Some farmers have resorted to mowing infested spots while the plants were still green. In such cases the straw is allowed to dry and then burned. Others have avoided running machinery through such spots and have allowed the grass to mature, after which wheat straw was piled on the areas and burned off. Both methods seem to have decreased the percentage of goat grass considerably, but it is doubtful if such methods ever accomplish complete eradication.

Where the plants are distributed as single plants or small clumps over a large acreage, continuously sown to wheat, the problem of eradication is still more difficult. This situation has been handled rather efficiently by some farmers, however. The general procedure in such cases has been to prepare the wheat seed bed as usual, but to defer sowing until after the fall rains have begun. At this time the goat grass germinates rapidly and most of it emerges in a very short time. As soon as the grass is well up, the fields are double disked and the wheat sown immediately. The disking kills most of the plants and halts the growth of the few that are left. The wheat seedlings therefore secure a favorable start and little trouble has been experienced with the grass in fields handled in this manner.

It seems therefore that, while goat grass is a troublesome wheat-field weed and is spreading slowly in the hard red winter wheat growning section of central Kansas, there will be no great difficulty in keeping it under reasonable control.

SOME ASPECTS OF HAY FEVER[1]

ELSA HORN

I wish to present to you some biologic and botanical aspects of hay fever, touching about two or three minutes on each. The subject is so complex and so important to the comfort of humanity that it is difficult to know which phase needs the greater emphasis.

Hay fever is just one manifestation in man of hypersensitivity or anaphylaxis to one or more specific foreign proteins. Other manifestations of the same thing are bronchial asthma, eczema, hives, uticaria, and some cases of migraine or sick headache, coitis (gastrointestinal upset), and other less clearly defined conditions grouped together as allergic diseases. Allergy means literally **altered energy or altered reactivity** (1) in the tissues of the body (whatever this alteration is) to an environmental change of those tissue cells. The tendency to become sensitive appears to be hereditary and the evidence seems to indicate that the inheritance of allergy follows the Mendelian law probably as a dominant characteristic. From 1 to 2 per cent of the population in the United States is afflicted with hay fever and about 10 per cent with its kindred forms of hypersensitiveness.

This environmental change in the body tissue cells appears to be caused, primarily, by the inhalation or ingestion of some foreign protein and its absorption through the mucuous membrane of the respiratory tract or the gastro-intestinal tract. The reactions of the body cells to the foreign protein is called hypersensitivity. Just what the reaction is within the body cells is pure hypothesis according to Vaughn[1]. Since 1910 it is assumed that it is related to or identical with anaphylaxis—a condition observed in immunological experimentation, occurring in animals upon second injections, after about 10 days of some protein like white of egg. The dogs or guinea pigs would develop symptoms of asthma and die within a few minutes. Such a terrific reaction came to be called anaphylactic shock. What happens in this curious phenomenon of anaphylaxis is also hypothesis. These animal experiments, however, have been the basis for all immunology studies, and the successful treatment of hay fever and its kindred manifestations has been based upon these theories; and also based upon the assumption that hypersensitivity and anaphylaxis are identical.

The reaction to a protein is specific. Therein lies one of the problems of treatment. Some idea of specific proteins is gained when it is remembered that a living cell will assimilate amino acids

1. Contribution No. 295 from the Department of Botany and Plant Pathology, Kansas State Agricultural College, Manhattan, Kansas.

for the purpose of growth, reproduction, and protoplasmic repair. Adberhalden (2) has calculated that 20 amino acids could form at least 2,432,902,008,176,640,000 different proteins and this does not include the vast number of proteins that can be produced by the same combinations of amino acids, but in varying proportions, or those produced by different groupings or locations in the protein molecule.

A patient can not be desensitized until the particular protein or proteins to which he is sensitive is known. The search for the causitive protein is often a long drawn out affair. Many a man has found freedom from symptoms on a fishing or camping or business trip; has subsequently established his family thither, only to find later that his cat or dog or pillow or his wife's face powder has been the cause. Many a hay fever resort has been established in such a camp site, only to be rendered ineffective because the ragweed follows cultivation of gardens around such resorts. It is exceedingly important that the diagnosis although simple be done with care and that the injections be definitely of the specific protein in correct mathematical proportion, otherwise temporary anaphylactic reactions may occur, which though not fatal as in the experimental animals may be severe. This requires the practice of thorough specialists. Among the inhalants which produce hay fever, etc., are pollens, animal epidermal emanations, dust of feathers, animal furs, orris root of cosmetics, dusts, bacteria, flour, etc. Among the ingestions causing symptoms are foods as strawberries, eggs, clams, potatoes, etc. If the causative protein can be eliminated from the patient's environment, this should be done since it is simpler than desensitization.

Since the pollens are by far the major foreign protein inhalants the botanical aspect of this problem is obvious. A list of plants compiled from all the literature on hay fevere I could peruse during the last two years, numbers some 250 trees, grasses and weeds,—mostly weeds—whose pollen is a causative factor. Almost with one voice the great specialists of hay fever say that for best results in relieving the victims of hay fever and asthma a botanical survey of the local section must be made and that good results are directly proportional to our knowledge of the nature, distribution and abundance of the local flora.

Six such more or less comprehensive surveys of the local hay fever floras with the aid of botanical assistants were made in and around New Orleans by Scheppegrell, President of American Hay Fever Prevention Association, New Orleans; San Antonio by Kahn (3); Kansas City by Duke (4); Denver by Waring (5); Oklahoma City by Balyeat (6); Chicago by Koessler (7); and Southern California by Piness (8). The survey of Chicago including pollen studies revealed the astounding fact that 1200 tons of ragweed pollen were produced and floated in the air during the summer of 1926.

Accurate botanical knowledge of local floras is the urgent need in the botalical aspect of the hay fever problem.

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3. Kahn, I. S. Botany of Southwest Texas with Reference to Hay Fever and Asthma. Jour. Amer. Med. Assn. 82:871, March 15, 1924.

4. Duke, W W. and Durham, O. C. Botanic Survey of Kansas City of Missouri and Neighboring Rural Districts with Reference to Flora Responsible for Hay Fever, Asthma and Dermatoses. Jour. Amer. Med. Assn., 82:939-944, Mar. 22, 1924. (Also pub. as Chap. X of Duke, W W., Allergy, Asthma, Hay Fever, Urticaria, and Allied Manifestations of Reaction. C. V. Mosby & C., St. Louis, 1926.)

5. Waring, J. J. Hay Fever Plant Survey of City and County of Denver, Colo, Med., 22:194-199. June, 1925.

6. Balyeat, R. M. Survey of Oklahoma Flora; 121 Cases of Seasonal Hay Fever. Jour. Okla. Med. Assn. 19:59-64, March, 1926.

7. Koessler, K. K. and Durham, O. C. A System for an Intensive Pollen Survey with a Report of Results in Chicago. Jour. Amer. Med. Assn. 86:1204-1209. April 17, 1926.

8. Piness, G., et al. Botanical Survey of Southern California in Relation to the Study of Allergic Diseases. Bull. So. Cal. Acad. Sci. 25:37-47. May 31, 1926.

FLORA OF WABAUNSEE COUNTY, KANSAS

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During 1926 and 1927 the author collected plants in Wabounsee County, Kansas. The material was used as a basis for a Master's thesis at Kansas State Agricultural College. Previous to 1898 collections were made in Wabaunsee County by J. B. Norton, G. L. Clothier and A. S. Hitchcock, seemingly in the northern portion of the county.

Wabaunsee County is an area of 804 square miles having altitudes varying from 1000 to 1900 feet. Small streams are numerous thruout the county, the east and west portions of the county are undulating prairie, but the north and central portions are hilly breaking into bluffs along the streams. Thick ledges of limestone underlie the entire county. Glacial drift is exposed in the northern and eastern portions.

An area near McFarland is of outstanding local interest because of the native Junipers or red cedars growing on a steep north bluff (150-200 feet) It is the only such area in the county to my knowledge. The bluff has been protected from the fires that swept thru the county and also from animals and prairie grasses. The Juniper seedlings have had sufficient time and protection to become established and have grown to fair sized trees.

The variety of environments thruout the county, that is, the high prairie, wet ravines, springs and woods, make it very favorable for a diversity of species, but because of continuous dry winters and moist summers grass thuroly dominates the vegetation.

Previous to 1853 the flora of the county was undisturbed, but with the coming of the pioneers to the county in 1853-54 came several factors for which man was responsible. These factors were the prairie fire, cultivation and destruction of plant species, and later (1880) the railroad and cattle.

The prairie fires are reported to have swept thru portions of the county in the years 1869, 1870, 1871, 1873, 1889 and 1891. These nearly annual fires gave the established species no chance to spread further or conquer barriers and the introduced species no opportunity to become established. As soon as the pioneer could break the virgin soil it meant destruction of certain species and introduction of others which were primarily food plants. The first railroad was built about 1880 and with this means of transportation the Alma Signal reported in 1891 that 15,000 foreign cattle grazed in the county that year. Constant pasturage limits some and even exterminates other species therefore new species able to withstand pasturage replace the native species. Physiographic factors such as

erosion, and soil leaching due to breaking of the sod and cutting away the timber are important in changing plant species in a local area.

On virgin prairie, where neither cultivation nor pasturage has been practiced, bright colored flowers are conspicuous. Where cultivation occurs plants of economic value have displaced the prairie, while in the case of areas that are pastured, one no longer finds the display of prairie flowers. Settlement has brot about many changes in the flora. Grasses are able to withstand cropping and spread without seed formation while other plants are crowded out.

There may not be a great difference in number of species but a vegetation differing in appearance. Up to date 495 species have been reported from the county. The three families which have the largest number of species are: composites 65 species, grasses 42 species, and legumes 31 species.

I have observed **Argemone intermedia** only at the extreme western border of the county. It has likely migrated to that point from the west as 15 miles west the plant is quite abundant on waste land. **Cactus missouriensis** is not abundant in the county, as I have observed it only in one locality northwest of Eskridge. It, too, is probably a migrant from the west. The greatest number of species have migrated from the east to the west as was pointed out before the Kansas Academy of Science in the spring of 1928 by Dr. F. C. Gates[1].

Summary

1. Wabaunsee County is located in the eastern third of the State of Kansas. It varies in altitude from 1000 to 1900 feet. Small streams are numerous thruout the county. The east and west portions of the county are undulating prairie, but the north and central portions are hilly breaking into bluffs along the streams. Thick ledges of limestone underlie the entire county. Glacial drift is exposed in the northern and eastern portions. Areas which have been protected from fires, tramping by stock and cultivation, such as high bluffs and steep slopes along streams with sufficient moisture, support quite a dense tree growth. Otherwise the area is open prairie. One area of local interest supports growth of native Junipers.

2. In 1899. A. S. Hitchcock listed about 380 species from the county, in 1926-29, as part of a thesis, the author collected and observed 282 species which included 115 not previously listed. Of the 213 species not collected in the limited time, a large proportion are without question in the county.

Annotated List of Plants of Wabaunsee County

In the following annotated list the species are arranged in alphabetical order by families. For identification the second edition of "Illustrated Flora of the United States and Canada" by Britton and

1. Gates, F. C. Kansas Botanical Notes, 1923-1928. Trans. Kans. Acad. Sci. 31:49-50. 1929.

Brown was used and in certain cases comparisons were made with specimens in the Kansas State College Herbarium.

Annotation and collection numbers are given only for plants collected during the present study, (1926-1929).

An "H" at the extreme right indicates that the species is on Hitchcock's List which was based on collections made previous to 1898.

ACANTHACEAE

Dianthera americana L. -- H.
Ruellia ciliosa Pursh. Herb, common in moist and dry soil. 20 ---- H.
Ruellia strepens L. -- H.

ACERACEAE

Acer negundo L. Tree, common in moist soil. 189 -------------- H.
Acer saccharinum L. Tree, well distributed thruout the county. 181

AESCULACEAE

Aesculus arguta Buckl. Shrub, frequent in damp woods. 146 ---- H.

AIZOACEAE

Mollugo verticillata L. -- H.

ALISMACEAE

Sagittaria ambigua J. G. Smith ------------------------------- H.
Sagittaria latifolia Willd. Herb, common in wet places. 101 ----- H.

AMARANTHACEAE

Acnida tamariscina (Nutt.) Wood. ---------------------------- H.
Amaranthus blitoides S. Wats -------------------------------- H.
Amaranthus graecizans L. ------------------------------------ H.
Amaranthus retroflexus L. ----------------------------------- H.
Amaranthus spinosus L. -------------------------------------- H.

ANACARDACEAE

Rhus crenata (Mill.) Greene. One shrub on roadside. 162
Rhus glabra L. Shrub, abundant on rocky hillsides. 29 ---------- H.
Rhus trilobata Nutt. Shurb, common on rocky hillsides. 59. ------ H.
Toxicodendron radicans (L) Kuntze. Liana, common in county --H.

ANONACEAE

Asimina triloba (L.) Dunal. ---------------------------------- H.

APIACEAE

Eryngium yuccaefolium Michx. Herb, common along dry banks and prairies. 34.
Chaerophyllum texanum Coult. & Rose (?) Herb, in moist woods. 152
Cicuta maculata L. Herb, common along creeks & low grounds. 282 H.
Spermolepis patens (Nutt.) Robinson ------------------------- H.
Washingtonia longistylis (Torr.) Britton ---------------------- H.
Zizea aurea (L.) Koch -- H.
Cogswellia foeniculacea (Nutt.) Coult. & Rose. Herb, abundant on prairies., flowering in April and May. 149. -------------- H.
Pleiotaenia nuttallii (DC) Coult and Rose. Herb, common on rocky hillsides. 55. ------------------------------------- H.
Sanicula marylandica L. Herb, frequent in moist woods. 201. ---- H.

APOCYNACEAE

Apocynum cannabinum L. ---------------------------------- H.

Apocynum sibiricum Jacq. Herb, common in waste and borders of cultivated fields.

ARACEAE

Arisaema dracontium (L) Schott. Herb, frequent in moist shaded soil. 238.

Arisaema triphyllum (L.) Torr. ------------------------------ H.

ASCLEPIADACEAE

Acerates angustifolia (Nutt.) Dec. Herb, occasional in dry soil. 56

Acerates lanuginosa (Nutt.) Dec. Herb, rare in dry soil. 194.

Asclepias sullivantii Engelm. ------------------------------ H.

Asclepias syriaca L. -- H.

Asclepias tuberosa L. Herb, common on hillsides and meadows. 9. H.

Asclepias verticillata L. Herb, common on prairies. 278. -------- H.

Asclepiodora viridis (Walt) Gray. Herb, common in dry soil. 11. -- H.

BALSAMINACEAE

Impatiens pallida Nutt. ------------------------------------- H.

BERBERIDACEAE

Podophyllum peltatum L. Herb, occasional in southern and central part of the county in shaded moist soils. 143. ---------- H.

BETULACEAE

Corylus americana. Shrub, occasional on borders of woods. 370. -- H.

Ostrya virginia (Mill.) Willd. -------------------------------- H.

BIGNONIACEAE

Catalpa speciosa Warder. Tree, commonly cultivated and escaped from cultivation, flowering in June. 185.

BORAGINACEAE

Lappula virginiana (L.) Greene ------------------------------ H.

Lithospermum linearifolium Goldie. Herb, very common on dry upland soil, flowering in April. 133. --------------------- H.

Onosmodium molle Michx. ------------------------------------ H.

Onosmodium occidentale Mackenzie. Herb, frequent on dry hillsides, flowering in May. 174.

BRASSICACEAE

Alliaria alliaria Britton. Herb, occasional in moist waste places. 147.

Arabis canadensis L. -- H.

Brassica campestris L. Herb, collected along railroad. 159.

Brassica juncea (L.) Cosson. ---------------------------------- H.

Brassica nigra (L.) Koch. Herb, growing in roadside ditch east of Eskridge, flowering in June. 29.

Bursa bursa-pastoris (L) Britton. Herb, abundant in waste places. 150

Dentaria laciniata Muhl. Herb, occasional in damp rich woods. 141.

Draba caroliniana Walt. Herb, common on prairies. 118.

Draba cuneifolia Nutt. -------------------------------------- H.

Lepidium densiflorum Schrad. ------------------------------ H.
Radicula palustris (L.) Moench. ------------------------------ H.
Radicula sessiliflora (Nutt.) Greene. ------------------------------ H.
Radicula sinuata (Nutt.) Greene. Herb, frequent in waste grounds. 168.
Sisymbrium officinalis R. Br. ------------------------------ H.
Sophia incisa (Engelm) Greene. ------------------------------ H.
Sophia pinnata (Walt.) Howell. Herb, frequent in waste grounds. 158.
Thlaspi arvense L. Herb, occasional in railroad stock yards. 195.

CACTACEAE

Cactus missiouriensis Sweet. Rare fleshy herb, in dry rocky soil. One cluster of specimens growing 2 1-2 miles northwest of Eskridge. 205.
Opuntia humifusa Tourn. Fleshy herb, frequent in dry open prairie. 46. ------------------------------ H.

CAMPANULACEAE

Campanula americana L. ------------------------------ H.
Lobelia leptostachys A. DC. Herb, on prairie. ------------------------------ H.
Specularia leptocarpa (Nutt.) A. Gray. Herb, frequent in moist soils. 265.
Specularia perfoliata (L.) DC. Herb, common in moist shaded or partially sunny habitat. 7. ------------------------------ H.

CANNABINACEAE

Cannabis sativa L. Herb, occasional, growing in fine moist soil. 116. H.
Humulus lupulus L. ------------------------------ H.

CAPRIFOLIACEAE

Sambucus canadensis L. High schrub, common on rich moist soil. 47 H.
Symphoricarpos symphoricarpos (L.) MacM. Shrub, abundant in lowland pastures, flowering in July. 100. ------------------------------ H.
Triosteum perfoliatum L. Herb, occasional in dry upland soil. 176.

CARYOPHYLLACEAE

Cerastium brachypodum Engelm. Herb, frequent in pastures and meadows. 156.
Saponaria officinalis L. Herb, in partial shade, escaped from cultivation, flowering in June. 3. ------------------------------ H.
Silene antirrhina L. Herb, frequent in dry upland soil. 172. ------ H.
Silene stellata L. Herb, frequent in moist soil. 261. ------------------------------ H.

CASSIACEAE

Cercis canadensis L. Tree, common in woods. 144. ------------------------------ H.
Chamaecrista fasiculata (Michx.) Greene. ------------------------------ H.
Gleditsia triacanthos L. Tree, common in woods. 242. ---------- H.
Gymnocladus dioica (L.) Koch. Tree, frequent in woods. -------- H.

CELASTRACEAE

Celastrus scandens L. Liana, common in woods twining on trees and shrubs, flowering in May. 63. ------------------------------ H.
Euonymus atropurpureus Jacq. Herb, in moist soils. 206. -------- H.

CHENOPODIACEAE

Chenopodium album L. Herb, common on borders of cultivated fields. 106.
Chenopodium boscianum Moq. ---------------------------------- H.
Chenopodium hybridum L. -- H.
Chenopodium leptophyllum (Moq.) Nutt. ----------------------- H.
Chenopodium leptophyllum var. subglabrum S. Wats. ---------- H.
Cycloloma atriplicfolium (Spreng.) Coult. -------------------- H.
Monolepis nuttalliana (R. & S.) Greene. ---------------------- H.
Salsola pestifer A. Nelson. Herb, frequent in the north and west portion of the county. A troublesome weed. 267.

COMMELINACEAE

Commelina virginica L. -- H.
Tradescantia bracteata Small. Herb, common along moist banks. 179.

COMPOSITAE

Achillea millefolium L. Herb, abundant on prairies. 23. ---------- H.
Agoseris cuspidata (Pursh.) D. Dietr. Herb, frequent on upland prairies and rocky slopes. Flowering April. 31.
Ambrosia elatior L. Herb, common in dry soil, flowering from July. 91. -- H.
Ambrosia psilostachya DC. Herb, found in wet ditches. 96. ------ H.
Ambrosia trifida L. Herb, in river bottoms. -------------------- H.
Antennaria campestris Rydberg. Herb, common on upland soil. 125. H.
Antennaria neglecta Greene. Herb, in open woods, flowering in Apr. 2.
Arctium minus Schk. -- H.
Artemisia dracunculoides Pursh. -------------------------------- H.
Artemisia graphaliodes Nutt. ----------------------------------- H.
Artemisia kansana Britton. Herb, occasional in dry prairies. 188.
Artemisia ludoviciana Nutt. Herb, common on upland prairies. 109.
Aster drummondii Lindl. Herb, frequent on dry banks. Oct. 299
Aster laevis L. --- H.
Aster multiflorus Ait. -- H.
Aster sericeus Vent. Herb, occasional in dry prairie soil. 290.
Aster vimineus Lam. Herb, common on dry upland soil. 300.
Boebera papposa (Vent.) Rydb. Herb, frequent in dry prairies. 230. H.
Brauneria pallida (Nutt.) Britton. Herb, common in prairies. 277. H.
Brauneria purpurea (L.) Moench. Herb, common thruout the county on the prairies, flowering from June. 50.
Chrysanthemum leucanthemum L. Herb. indegenous to localities in dry prairies, flowering in June. 19. -------------------- H.
Cirsium altissimum (L.) Spreng. -------------------------------- H.
Cirsium lanceolatum (L.) Hill. --------------------------------- H.
Cirsium undulatum (Nutt.) Spreng. (?) Herb, in prairie soil. 75. H.
Erigeron philadelphicus L. Herb, in moist meadows. 170.
Erigeron ramosus (Walt.) B. S. P. Herb, common in dry prairies. 190. -- H.

Eupatorium altissimum L. ---------------------------------- H.
Eupatorium urticaefolium Reichard. ------------------------ H.
Euthamia graminifolia (L.) Nutt. -------------------------- H.
Grindelia squarrosa (Pursh.) Dunal. ----------------------- H.
Helenium tenuifolium Nutt. Herb, five plants along railroad near Wabaunsee. (Gates, No. 13585).
Helianthus annuus L. -------------------------------------- H.
Helianthus grosse-serratus Martens. ----------------------- H.
Helianthus maximiliani Schrad. ---------------------------- H.
Helianthus orgyalis DC. ----------------------------------- H.
Helianthus petiolaris (Nutt.) Herb, in dry waste soil. 180. ------ H.
Helianthus scaberrimus Ell. ------------------------------- H.
Heliopsis scabra Dunal. ----------------------------------- H.
Hieracium longipilum Torr. Herb, occasional in prairie soil. 287.
Kuhnia eupatorioides L. ----------------------------------- H.
Lactuca floridana (L.) Gaertn. Herb, common in moist woods. 224. H.
Lactuca spicata (Lam.) Hitch. Herb, common in moist soil. 226.
Leptilon canadense (L.) Britton --------------------------- H.
Liatris punctata (Hook) Kuntze. --------------------------- H.
Liatris scariosa (L.) Hill. Herb, frequent in prairies. 284. ------ H.
Mesadenia atriplicifolia (L.) Raf. ------------------------ H.
Mesadenia tuberosa (Nutt.) Britton. Herb, common in moist and dry soil. Flowering from June. 140. ------------------ H.
Ratibida columnaris (Sims) D. Don. Herb, common on dry roadsides and prairies, flowering from June. 49. ------------- H.
Ratibida pinnata (Vent.) Barnhart. ------------------------ H.
Rudbeckia hirta L. -- H.
Senecio plattensis Nutt. Herb, frequent in pastures & meadows. 160. H
Serinia oppositifolia (Raf.) Kuntze. Herb, in moist pasture land. 169.
Silphium integrifolium Michx. Herb, common in dry prairies. 294. H.
Silphium laciniatum L. Herb, common on dry prairies and roadsides. 57. -- H.
Solidago canadensis. Herb, frequent in upland soil. 296.
Solidago missouriensis Nutt. Herb, common on prairies. 256. ---- H.
Solidago rigida. Herb, frequent in dry soil. 297.
Sonchus asper (L.) Hill. ---------------------------------- H.
Taraxacum vulgare Lam. Herb, in waste land. ---------------- H.
Tragopogon pratensis L. Herb, occasional in dry soil. 93.
Verbesina alternifolia Brittan. --------------------------- H.
Vernonia baldwinii Torr. ---------------------------------- H.
Vernonia fasciculata Michx. ------------------------------- H.
Vernonia missurica Raf. Herb, abundant in prairies. 274.
Xanthium americanum Walt. Herb, abundant in waste grounds and cultivated fields, fruiting in August. 73. ------------- H.

CONVOLVULACEAE

Convolvulus repens L. Herb, common on dry prairies and waste grounds. 171.

Convolvulus sepium L. Herb, common on waste grounds. 15. ----- H.
Evolvulus pilosus Nutt. -- H.
Ipomoea hederacea Jacq. Herb, common in moist rich cultivated fields, flowering from July. 254. -------------------- H.
Ipomoea pandurata (L.) Meyer. ------------------------------ H.
Ipomoea purpurea (L.) Lam. --------------------------------- H.

CORNACEAE

Cornus asperfolia Michx. Shrub, commonly at the borders of woods, flowering in June. 24. --------------------------- H.
Cornus amomum Mill. -- H.

CRASSULACEAE

Penthorum sedoides L. -------------------------------------- H.

CUCURBITACEAE

Pepo foetidissima HBK. Vine, frequent in dry waste soil. 86. ---- H.
Sicyos angulatus L. Vines, frequent in moist shaded soil, flowering from July. 226. ----------------------------------- H.

CUSCUTACEAE

Cascuta sp. Vine, frequent in low grounds, flowering in June. 186.
Cuscuta polygonorum Engelm. -------------------------------- H.

CYPERACEAE

Carex crus-corvi Shuttlw. ---------------------------------- H.
Carex festucacea Schkuhr. Herb, in dry soils. 232. ------------- H.
Carex hystericina Muhl. Herb, in wet ravine. 229. ------------ H.
Carex laxiflora Schuttlw. ---------------------------------- H.
Carex muhlenbergii var. xalapensis. ------------------------- H.
Carex pennsylvanica Lam. Herb, common on dry prairies. 122.
Carex stricta Lam. Herb, in moist soil, fruiting in May. 233.
Carex vulpinoidea Michx. Sedge, frequent in wet soil. 257. ------ H.
Cyperus esculentus L. -------------------------------------- H.
Cyperus filiculmis Vahl. Sedge, occasional in dry meadows. 268. -- H.
Cyperus speciosus Vahl. ------------------------------------ H.
Eleocharis tenuis (Willd.) Schultes. Herb, in wet ditch. 104.
Eleocharis palustris (L.) R. & S. ---------------------------- H.
Scirpus atrovirens Muhl. Sedge, common in wet ravines. 258. ---- H.
Scirpus lineatus Michx. Herb, in wet ditch on upland soil. 95. ---- H.
Scirpus pallidus (Britton) Fernald. Herb, common in wet ravines. 85
Scirpus validus Vahl. --------------------------------------- H.

EQUISETACEAE

Equisetum sp. Herb, frequent in moist soil. 214. --------------- H.

EUPHORBIACEAE

Acalpha ostryaefolia Ridd. ----------------------------------- H.
Acalypha virginica L. -- H.
Chamaesyce preslii (Guss) Arthur. Herb, frequent in dry waste soils. 280.
Chamaesyce maculata (L.) Small ---------------------------- H.

Chamaesyce serpens (HBK) Small. ---------------------------- H.
Chamaesyce stictospora (Engelm.) Small --------------------- H.
Chamaesyce zygophylloides (Boiss.) Small ------------------- H.
Croton capitatus Michx. ------------------------------------ H.
Croton monanthogynus Michx. Herb, frequent in dry soil. 279. -- H.
Dichrophyllum marginatum (Pursh.) Kl. and Garcke. Herb, abundant in dry and moist soil. 271 ---------------------------- H.
Poinsettia dentata (Michx.) Small -------------------------- H.
Poinsettia heterophylla (L.) Kl. and Garcke. ---------------- H.
Zygophyllidium hexagonum (Nutt.) Spreng. ------------------- H.
Tithymalopsis corallata Kl. and Garcke. Herb, in upland rocky soil. 111 -- H.
Tithymalus cyparissias (L.) Hill. Herb, in open prairie. 167.
Tithymalus missouriensis (Norton) Small. Herb, in open prairie. 61. H
Tragia ramosa Torr. -- H.

FABACEAE

Amorpha canescens Pursh. Herb, very common in dry prairies. 71. H.
Amorpha fruticosa L. Herb, common in wet ditches. 208. -------- H.
Amorpha nana Nutt. Herb, in dry upland soil, flowering in May. 207.
Astragalus carolinianus L. --------------------------------- H.
Baptisia australis (L.) R. Br. Herb, common on dry prairies. 51. H.
Baptisia bracteata Ell. Herb, common on dry prairies. 51. ------ H.
Baptisia leucantha T and G. Herb, common in dry prairies. 113. H.
Falcata pitcheri (T. & G.) Kuntze -------------------------- H.
Geoprumnon crassicarpum (Nutt.) Rydb. Herb, in prairies. 130. --H.
Geoprumnon plattense (Nutt.) Rydb. Herb, rare in prairie. 223.
Glycyrrhiza lepidota Pursh. Herb, in prairie. 196. ------------ H.
Lespedeza capitata Michx. Herb, frequent on prairies. 228. ------ H.
Lespedeza violacea (L.) Pers. ------------------------------ H.
Medicago sativa L. Herb, commonly cultivated. --------------- H.
Meibomia canescens (L.) Kuntze. ---------------------------- H.
Meibomia grandiflora (Walt.) Kuntze. ----------------------- H.
Meibomia illinoensis (Gray) Kuntze. Herb, common in dry prairie. H.
Melilotus alba Desv. Herb, abundant and widely distributed on dry waste soils. Sometimes it is cultivated. 70. ------------ H.
Melilotus officinalis (L.) Lam. Herb, abundant and widely distributed on dry waste land, flowering from June. 69. ---------- H.
Parosela dalea (L.) Britton -------------------------------- H.
Petalostemum candidum (Willd.) Michx. Herb, common on dry upland prairies, flowering in June. 67. ---------------------- H.
Petalostemum multiflorum Nutt. ----------------------------- H.
Petalostemum purpureum (Vent.) Rydb. Herb, very common on dry upland prairies, flowering in June. 66. ----------------- H.
Psoralea argophylla Pursh. Herb, rare in prairies. 79. --------- H.
Psoralea esculenta Pursh. Herb, occasional in dry prairies. 184. H.
Psoralea floribunda Nutt. Herb, abundant in prairies. 35. -------- H.
Robinia pseudoacacia L. Tree, common in timber. 61. ------------ H.
Trifolium pratense L. Herb, frequently cultivated as a forage crop,

flowering from May to September. 209. ---------------- H.
Trifolium repens L. Herb, common thruout county. ------------ H.
Strophostyles pauciflora (Benth.) Britton. -------------------- H.
Vicia sparsifolia Nutt. Herb, occasional in dry soil. 42.

FAGACEAE

Quercus macrocarpa Michx. ------------------------------------ H.
Quercus muhlenbergii Engelm. -------------------------------- H.
Quercus prinoides Willd. -- H.

GENTIANACEAE

Centaurium texense Griseb. Herb, occasional in dry open soil. 21.
Gentiana puberula Michx. -------------------------------------- H.

GERANIACEAE

Geranium carolinianum L. Herb, common in waste ground.

GROSSULARIACEAE

Grossularia missouriensis (Nutt.) Cov. & Britton. Shrub, common in moist woods, flowering in April. 155. ------------------ H.

HYDROPHYLLACEAE

Hydrophyllum virginianum L. ---------------------------------- H.
Nyctelea nyctelea (L.) Britt. Herb, common in damp soil, usually in woodlands, flowering in May. 177. ------------------ H.

HYPERICACEAE

Hypericum cistifolium Lam. ------------------------------------ H.

IRIDACEAE

Sisyrinchium campestre Bicknell. Herb, occasional in prairie. 248. H.
Sisyrinchium angustifolium ------------------------------------ H.

JUGLANDACEAE

Hicoria cordiformis (Wang.) Britton. ------------------------------ H.
Juglans nigra L. Tree, common in moist soils along streams. 60. H.

JUNCACEAE

Juncus dudleyi Wiegand. Herb, common in wet ravines. 221
Juncus torreyi Coville. -- H.
Juncus tenuis Willd. -- H.

LAMIACEAE

Agastache nepetoides (L.) Kuntze ------------------------------ H.
Hedeoma hispida Pursh. Herb, in dry stony soil. 234. ------------ H.
Lycopus americanus Muhl. Herb, common in wet soil. 98. --------- H.
Marrubium vulgare L. Herb, occasional in waste lands. 262.
Mentha canadensis L. -- H.
Monarda fistulosa L. Herb, abundant in moist shaded soils. 14. -- H.
Napeta cataria L. Herb, in moist soil. 142. ---------------------- H.
Prunella vulgaris L. Herb, common fields, woods and waste places, flowering from June to September. 276. -------------- H.
Salvia lanceifolia Poir. Herb, frequent in dry soil. 134. -------- H.
Salvia pitcheri Torr. -- H.
Scutellaria parvula Michx. Herb, occasional in dry soil. 135

Teucrium canadense L. Herb, common in moist shaded soils. 14.
Teucrium occidentalis A. Gray. ---------------------------------- H.

LILIACEAE

Allium canadense L. Herb, common in prairies, flowering in May. 217.
Allium stellatum Ker. -- H.
Asparagus officinalis L. Herb, rare in open fields, escaped from cultivation. 204.
Erythronium albidum Nutt. Herb, common on upland soils. 131.
Erythronium americanum Ker. Herb, common in moist rich woods. 145
Erythronium mesachoreum Knerr. Herb, common near woods. 120. H.
Nothoscordum bivalve (L.) Britton. Herb, frequent in prairie. 136.
Polygonatum commutatum (R. & S.) Dietr. Herb, frequent in moist woods, flowering in May. 241. ---------------------- H.
Smilax herbacea L. in moist woods. 68.
Smilax hispida Muhl. Liana, common in woods. 105. ------------ H.
Zygadenus nuttallii Gray. Herb, common in prairies. 178.

LINACEAE

Linum sulcatum (Riddle) Small. Herb, common on open prairies. 28. H

LOASACEAE

Mentzelia oligosperma Nutt. ---------------------------------- H.

LYTHRACEAE

Lythrum alatum Pursh. -- H.

MALVACEAE

Abutilon abutilon (L.) Rusby. Herb, in low rich grounds. 80. ---- H.
Callirhoe alceoides (Michx.) A. Gray. Herb, common in dry prairies. 250. -- H.
Callirhoe digitata Nutt. Herb, frequent on rocky hillslopes. 183.
Callirhoe involucrata (T & G) Gray. Herb, common in variable soils. 1.
Callirhoe triangulata Leavenw. Herb, in prairie soil. 200.
Hibiscus militaris Cav. --------------------------------------- H.
Hibiscus trionum L. Herb, common in waste places. 281. -------- H.
Malva rotundifolia L. --- H.
Sida spinosa L. -- H.

MALACEAE

Crataegus coccinioides Ashe. Tree, occasional in woods, 151.

MENISPERMACEAE

Menispermum canadense L. Vine, abundant in moist woods. 45 -- H.

MIMOSACEAE

Acuan illinoensis (Michx.) Kuntze. ---------------------------- H.

MORACEAE

Morongia uncinata (Willd.) Britt. Herb, common in dry prairies. 8. H.
Morus alba L. Tree, occasional on upland soil. 253.
Morus rubra L. Tree, occasional on upland soils. 192. ----------- H.

Toxylon pomiferum Raf. Tree, frequent in dry or moist soils. Introduced as defense against stock in the early days. 182.

NYCTAGINACEAE

Allionia albida Walt. -- H.
Allionia linearis Pursh. Herb, common in dry soil. 94.
Allionia nyctaginea Michx. Herb, very common on moist and dry soils, flowering in May. 82. ------------------------- H.

OENOTHERACEAE

Anogra albicaulis (Pursh.) Brit. Herb, frequent in sunny habitats. 235
Chamaenerion angustifolium (L.) Scop. Erect herb, common in prairies. 275.
Gaura biennis L. Herb, common on dry banks. 295. -------------- H.
Gaura parviflora Dougl. ------------------------------------ H.
Hartmannia speciosa (Nutt.) Small. -------------------------- H.
Megapterium missouriense Sims. Herb, common in dry open soils, flowering in May. 16. ---------------------------- H.
Meriolix serrulata (Nutt) Walp. Herb common in open prairies. 199. H
Oenothera biennis L. --- H.
Raimannia lacinata (Hill) Rose. Herb, occasional in sandy soil. 138.
Stenosiphon linifolium (Nutt.) Britton. Herb, occasional in open soils, flowering in June. 52. ---------------------------- H.

OLEACEAE

Fraxinus americana L. Tree, common in moist woods. 252.
Fraxinus pennsylvanica Marsh. Tree, in moist soil. 246. ----------H.
Fraximus pennsylvanica lanceolata (Borkhausen) Sargent. Tree, in low ground and planted as an ornamental. ------------ H.

OPHIOGLOSSACEAE

Botrychium virginanum (L.) Sw. ---------------------------- H.

OROBANCHACEAE

Thalesia uniflora (L.) Britton ------------------------------ H.

OXALIDACEAE

Oxalis cymosa Small. Herb, common in waste soils. 27.
Oxalis stricta L. Herb, common in open fields, flowering in April. 48. 269. -- H.
Oxalis violacea (L.) Small. Herb, abundant in dry rocky soil, flowering in April. White flowers are rare. 163 -------------- H.

PAPAVERACEAE

Argemone alba --- H.
Argemone intermedia Sweet. Milky herb, rare in open sandy soil. 48.
Bicuculla cucullaria (L.) Millsp. Herb, in rich woods, flowering in April. 139. -------------------------------------- H.
Capnoides aureum -- H.
Capnoides micranthum (Engelm.) Britton. Herb, common in low damp woods and roadsides, flowering in April. 160.

PHRYMACEAE

Phryma leptostachya L. ------------------------------------ H.

PHYTOLACCACEAE

Phytolacca americana L. Herb, common in moist rich woods. 77.

PINACEAE

Juniperus virginiana L. Tree, common in farmyards and along moist bluffs and a few specimens along limestone ledges. 249. H.

Pinus sylvestris Ait. One tree cultivated in cemetery east of Wabaunsee. 103.

Thuja orientalis L. Tree, rarely cultivated in yards and cemetries. 165.

PLANTAGINACAE

Plantago aristata Michx. ---------- H.

Plantago lanceolata L. Herb, common in dry waste soils. 78.

Plantago media L. Herb, common in sunny places. 218. (H.)

Plantago purshii R. & S. Herb, in sunny habitat, flowering in June. 220

Plantago rugelii Dcne. ---------- H.

Plantago virginica L. Herb, in dry soil, flowering in May. 202.

PLATANACEAE

Platanus occidentalis L. Tree, frequent along streams. 43. ---------- H.

POACEAE

Agropyron repens (L.) Beauv. ---------- H.

Agropyron smithii Rydb. Grass, in moist soil. 247.

Andropogon furcatus Muhl. ---------- H.

Andropogon scoparius Michx. ---------- H.

Agrostis hyemalis (Walt.) B. S. P. Grass, frequent in wet ravines. June to August. 180.

Agrostis palustris Huds. ---------- H.

Bouteloua curtipendula Michx. ---------- H.

Bouteloua oligostachya (Nutt.) Torr. ---------- H.

Bromus japonicus Thunb. Grass, abundant on dry waste ground. 89.

Bulbilis dactyloides (Nutt.) Raf. Grass, frequent in prairies. 203.

Cenchrus pauciflorus Benth. ---------- H.

Chaetochloa lutescens (L.) Scrib. ---------- H.

Chaetochloa viridis (L.) Scrib. ---------- H.

Echinochloa crusgalli L. Beauv. Grass, in farmyards and waste places. 272. ---------- H.

Elymus canadensis L. ---------- H.

Elymus virginicus L. Grass, common in moist soils. 110.

Eragrostis capillaris (L.) Nees. ---------- H.

Eragrostis cilianensis (Major) Host. ---------- H.

Eragrostis pectinacea (Michx.) Steud. ---------- H.

Festuca nutans Willd. ---------- H.

Hordeum jubatum L. Grass, occasional in dry soils. 193. ---------- H.

Hordeum pusillum Nutt. ---------- H.

Koeleria cristata Pers. Grass, frequent in cultivated fields. 211.

Muhlenbergia cuspidata (Torr.) Nash. ---------- H.

Panicularia nervata (Willd.) Kuntze. ---------- H.

Panicum capillare L. -- H.
Panicum dichotomiflorum Michx. ---------------------------- H.
Panicum scribnerianum Nash. Grass, frequent in open soils. 236. H.
Paspalum ciliatifolium Michx. ---------------------------- H.
Phleum pratense L. Grass, occasionally cultivated. -------------- H.
Poa compressa L. Grass, abundant in dry and moist soils. -------- H.
Poa pratensis L. Grass, in lawns and generally escaped.
Schedonnardus paniculatus (Nutt.) Trelease. ------------------ H.
Sorghastrum nutans (L.) Nash. ---------------------------- H.
Spartina michauxiana Hitch. ------------------------------- H.
Sphenopholis obtusa (Michx.) Scribn. ---------------------- H.
Sporobolus cryptandrus (Torr.) A. Gray. -------------------- H.
Stipa spartea Trin. -------------------------------------- H.
Syntherisma sanguinale (L.) Dulac. ------------------------ H.
Tridens flava (L.) Hitch. --------------------------------- H.
Tripsacum dactyloides L. Grass, common thruout the county in moist habitats, flowering in June. 84. -------------------- H.
Uniola latifolia L. --------------------------------------- H.

POLEMONIACEAE

Phlox divaricata L. Herb, common in damp rich woods. 40.

POLYGALACEAE

Polygala verticillata L. ---------------------------------- H.

POLYGONACEAE

Polygonum aviculare L. Herb, common in dooryards and waste grounds. 90. ------------------------------------ H.
Polygonum convolvulus L. Herb, occasional in dry open soil. June to July. 286. ------------------------------------ H.
Polygonum erectum L. Herb, in waste soils. ------------------ H.
Polygonum lapathifolium L. ------------------------------- H.
Polygonum littorale Link. --------------------------------- H.
Polygonum muhlenbergii S. Wats. -------------------------- H.
Polygonum pennsylvanicum L. ------------------------------ H.
Polygonum persicaria L. ---------------------------------- H.
Polygonum punctatum Small. ------------------------------- H.
Polygonum ramosissimum Michx. --------------------------- H.
Polygonum scandens L. ----------------------------------- H.
Polygonum tenue Michx. Herb, occasional in wastes. July-Sept. 273 H.
Polygonum virginianum L. Herb, frequent in moist woods, flowering from July. 292. ------------------------------------ H.
Rumex acetosella L. -------------------------------------- H.
Rumex altissimus Wood. Herb, common in moist grounds, flowering in May. 210. ------------------------------------ H
Rumex britannica S. Wats. Herb, common in low waste grounds. 88.
Rumex crispus L. Herb, common in low moist wastes. 87. ------ H.

PORTULACACEAE

Portulaca oleracea L. ------------------------------------ H

POLYPODIACEAE

Pellaea atropurpurea (L.) Link. Herb, common in northern part of the county on limestone ledges. 154.

PRIMULACEAE

Androsace occidentalis Pursh. Herb, abundant in upland prairies, flowering in March and April. 124. ---------- H.

Steironema ciliatum (L.) Raf. Herb, frequent in moist grounds, flowering from June to August. 285. ---------- H.

PRUNACEAE

Prunus americana Marsh. Shrub, common in wastes, flowering in April. 231. ---------- H.

Prunus virginiana (L.) Mill. Shrub, common in moist soil, flowering in April. 53. ---------- H.

RANUNCULACEAE

Anemone decapetala Ard. Herb, common on upland prairies, flowering colors range from bluish purple to white. 126. ---------- H.

Anemone virginiana L. ---------- H.

Delphinium carolinianum Walt. ---------- H.

Delphinium tricorne Michx. ---------- H.

Delphinium virescens Nutt. Herb, common on upland soil. 18.

Ranunculus abortivus L. Herb, common in damp woods. 148.

Thalictrum dasycarpum Fisch. & Lall. ---------- H.

Thalictrum dioicum L. Herb, in moist woods, flowering in June. 64.

Viorna pitcheri (T. & G.) Britton. Vine, occasional in moist soils, flowering from June. 225. ---------- H.

RHAMNACEAE

Ceanothus americanus L. Shrub, frequent on rocky hill slopes. 112.

Ceanothus ovatus Desf. Low shrub, frequent on rocky slopes. 33.
var. pubescens. Low shrub on rocky hill slope. 107. ---------- H.

Rhamnus lanceolata Pursh. Shrub, common in waste grounds, fruit-in June. 225. ---------- H.

ROSACEAE

Agrimonia mollis (T. & G.) Britton ---------- H.

Agrimonia parviflora Soland ---------- H.

Fragaria virginiana Duchesne. Herb, common in moist soil. 251.

Geum canadense Tacq. ---------- H.

Rosa arkansana Greene. Shrub, frequent along roadsides. 187 ----H.

Rosa blanda Lindl. Shrub, occasional in sunny habitats. 245.

Rosa woodsii. Shrub, flowering in May. 215.

Rubus baileyanus Britton ---------- H.

Rubus canadensis L. ---------- H.

Rubus occidentalis L. ---------- H.

RUBIACEAE

Cephalanthus occidentalis L. ---------- H.

Galium aparine L. Herb, frequent in damp woods. 173. ---------- H.

Galium circaezans Michx. Herb, common in damp woods, fruiting in May. 175. ---------- H.

Galium concinnum Torr. and Gray. ---------------------------- H.
Galium triflorum Michx. -- H.
Houstonia angustifolia Michx. -------------------------------- H.
Houstonia minima Beck. Small herbaceous plant on dry prairie, reported to be extremely abundant east of Emporia in the spring season of 1927. I also collected specimens in Riley county this spring. 128.

RUTACEAE

Zanthoxylum americanum Mill. Shrub, occasional on rocky hillsides and woods, flowering in April before the leaves appear. 132. H.

SALICACEAE

Populus alba L. A rare cultivated tree. 237.
Populus deltoides Marsh. ------------------------------------- H.
Populus italica Moench. A rare cultivated tree. 191.
Populus sargentii Dode. Tree, common in moist soil. 244.
Salix amygdaloides Anders. ----------------------------------- H.
Salix cordata Muhl. --- H.
Salix longifolia Muhl. Tree, common along Kansas River. ------ H.

SANTALACEAE

Commandra umbellata (L.) Nutt. ------------------------------ H.
Commandra umbelate (L.) Nutt. ------------------------------- H.

SCROPHULARIACEAE

Afzelia macrophylla (Nutt.) Kuntze. ------------------------- H.
Conobea multifida (Michx.) Menth. -------------------------- H.
Mimulus geyeri Torr. Herb, below permanent spring. Rare. 219.
Mimulus ringens L. -- H.
Otophylla densiflora (Benth.) Small. ------------------------- H.
Pentstemon cobaea Nutt. Herb, common in dry prairies, flower- in June. 60. -- H.
Pentstemon grandiflorus Nutt. Herb, frequent on dry prairies. 212. H.
Scrophularia marylandica L. ---------------------------------- H.
Verbascum thapsus Torr. Herb, common in dry prairies. 44.
Veronica peregrina L. Herb, occasional in moist soil. 291.

SIMARUBACEAE

Ailanthus altissima (Miller) Swingle. Tree, escaped from cultivat'n 37

SOLONACEAE

Datura stramonium L. Fleshy herb, common in moist rich soil, flowering from June to September. 26. ------------------- H.
Lycium halimifolium Mill. ------------------------------------- H.
Physalis heterophylla Nees. ----------------------------------- H.
Physalis longifolia Nutt. --------------------------------------- H.
Physalis pumila Nutt. --- H.
Solanum carolinense L. Herb, common in dry and moist soils, flowering in July. 5. --- H.
Solanum elaeagnifolium Cav. ----------------------------------- H.
Solanum nigrum L. -- H.
Solanum rostratum Dunal. Herb, very common in waste soils, flower- in June. 4. -- H.

SPARGANIACEAE

Sparganium eurycarpum Engelm. -------------------------------- H.

STAPHYLEACEAE

Staphylea trifolia L. Shrub, occasional on the borders of woods, flowering in April. 152. ---------------------------- H.

TILIACEAE

Tilia glabra Vent. -- H.

TYPHACEAE

Typha latifolia L. Herb, common along creeks and in ponds, fruiting from August to September. 283. --------------- H.

ULMACEAE

Celtis occidentalis L. Tree, common in open woodlands. 32. ------ H.

Ulmus americana L. Tree, common in moist soil, flowering in March and April. Samaras ripe in May. 270. --------------- H.

Ulmus fulva Michx. Tree, common in timber. 54. --------------- H.

URTICACEAE

Parietaria pennsylvanica Muhl. ----------------------------- H.

Pilea pumila (L.) A. Gray. ------------------------------------ H.

Urtica gracilis Ait. Herb, abundant in moist waste soils. ---------- H.

VERBENACEAE

Lippia cuneifolia (Torr.) Stewd. ------------------------------ H.

Lippia lanceolata Michx. -------------------------------------- H.

Verbena angustifolia Michx. Herb, in prairie. ----------------- H.

Verbena bracteosa Michx. ------------------------------------ H.

Verbena canadensis (L.) Britton. Herb, occasional in dry rocky soil, flowering in April. 36. ----------------------------- H.

Verbena hastata L. -- H.

Verbena stricta Vent. Herb, very common in dry and moist soil, flowering from July to September. 30. ---------------- H.

Verbena urticifolia L. -- H.

VIOLACEAE

Calceolaria verticillata (Ort.) Kuntze. ------------------------ H.

Viola eriocarpa Schwein. Herb, common in moist woods, fruit mature in May. 161. -- H.

Viola palmata L. Herb, on dry rocky hillsides, flowering in Apr. 123 H.

Viola papilionacea Pursh. Herb, in moist woods, fruit mature in May. 157. -- H.

Viola pedatifida G. Don. Herb, very common in upland prairies, flowering in April. 137

Viola rafinesquii Greene. Herb. abundant in upland meadows. 127.

VITACEAE

Ampelopsis cordata Michx. ------------------------------------- H.

Parthenocissus quinquefolia (L.) Planch. Liana, abundant in moist soils in woods and along fences, fruiting in August. 114. H.

Vitis cinerea Engelm. -- H.

Vitis cordifolia Michx. Liana, occasional in moist soil. 264. ------ H

Vitis palmata Vahl. Liana, occasional in moist grounds. 198.

Vitus vulpina L. Liana, frequent in rich woods and borders of cultivated fields, flowering in April. 115. --------------- H.

GEOLOGY OF THE DEEP CREEK RESERVATION, UTAH, AND ITS ENVIRONS

ALBERT B REAGAN

Ouray, Utah

Introduction

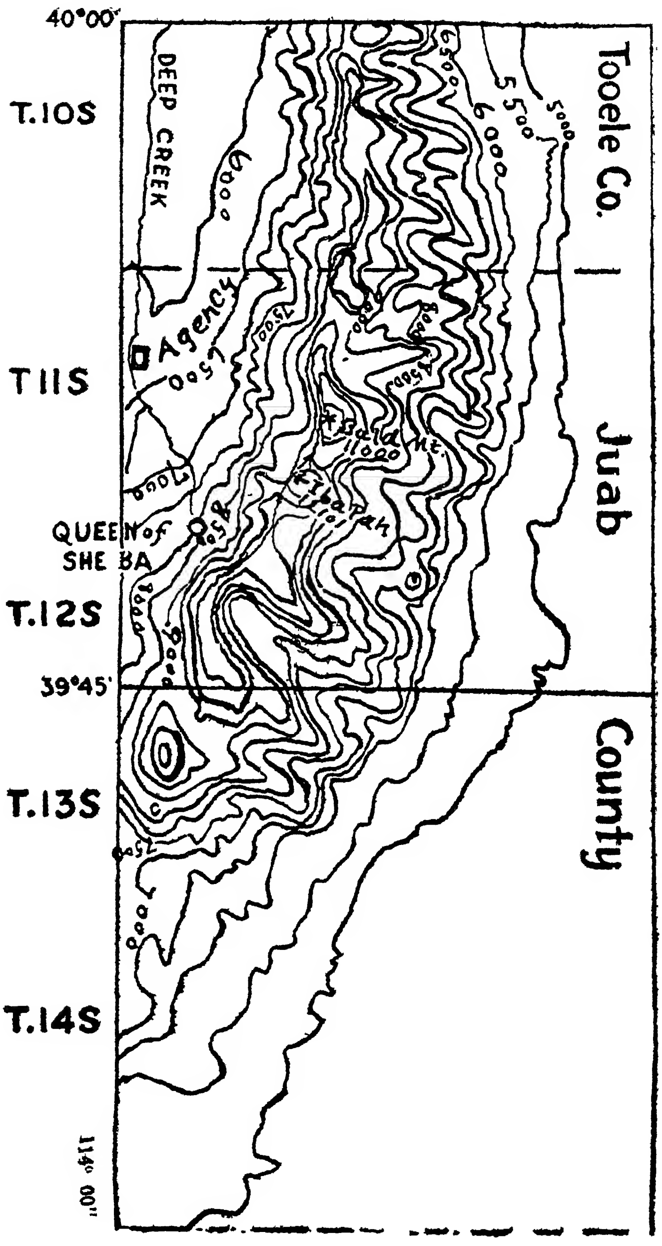
One hundred and fifty miles southwest of Salt Lake City, eight miles east of the western boundary of Utah and seventy miles south of Wendover Station on the Western Pacific railroad, is a north and south mountain range called the Deep Creek Range. It is one of the Basin ranges and is the result of a gigantic normal fault on its western side. The escarpment shows a displacement of about fourteen thousand feet, six thousand feet of which still remain, the crest rising six thousand feet above the Deep Creek valley to the westward. The fault-block is tilted eastward, gradually sloping to the foot of the Fish Spring range, to which it is a down-throw side. The main ridge culminates in Bald Mountain (eleven thousand feet in altitude), and Haystack or Ibapah Peak (twelve thousand one hundred and one feet in height). At the south terminus of the range a succession of faulting brings in a succession of westward fault-block spurs with eastward dipping strata, known collectively as the Spring Creek range. Another spur leading off eastward from Goodwin (Gold Hill) is known as the Clifton Mountains. The whole mountain series is the result of a succession of the north and south faults with strata dipping at a high angle to the eastward.

The Deep Creek valley west of the mountains is comprised of an ancient lake area surrounded in the main by the Deep Creek and Spring Creek ranges of mountains. This strip is drained by Deep Creek and its tributaries and is called "Lower Egypt" on account of its fertility, while the mountain districts amply take care of the country's stock. Among the settlers of the valley are George Etta, John Erickson, Cocks, Hibbards, Lees, Probert, Stuart, the Kelleys, George Fergison, the Felts, Snivelers, Hutsons, Bonamonts, Mulners, Sheridans, Mr. Hiks, Wade Parish, and the Weavers. The Deep Creek Indian Reservation also occupies one and three-fourths townships in the south-central part of the region.

Geological Formations

The west face of the main range is granite. The east and south slopes are sedimentary rocks as are the rocks in the Spring Creek range. The Clifton Gold-Hill region is granite with numerous intrusions of porphyry dikes. East and north of the mountains are Bonneville deposits, while those in the Deep Creek valley are Quarternary and Tertiary in age. Jurassic (?) and Cretaceous rocks also flank thse ranges in several detached localities.

*This paper was kindly edited by Prof. A. B. Sperry.—Editor.



MAP OF SPRING CREEK RESERVATION COUNTRY

Archean

The west face of the main ridge of the Deep Creek range is granite from near the Queen of Sheba mine north to the Juab County line, a distance of about seven miles. The area is about three miles in width from east to west. This granite is often coarse grained, light to red in color, and shows evidence of crushing, and decomposition. It contains orthoclase and plagioclase, also brown biotite, hornblende and magnetite. A dark colored plutonic rock is exposed at Crow Springs west of the Spring Creek range and is probably Archean in age, as the Paleozoics are superimposed in place upon it. The area exposed here is very small. (Some have considered this granite as of the Tertiary age.)

Algonkian (Not indicated on the map.)

At the Queen of Sheba mine a fourteen hundred and fifty-six foot tunnel was driven into the mountain side to tap the main vein from a lower level. The first one thousand feet of the tunnel showed coarse grained granite, the rest quartzite to shistose-quartzite (algonkian?) wedged with intrusive granite dikes.

Clifton Formation

The formation in the Gold-Hill-Clifton region is granite with numerous intrusions of porphyry dikes. The surface exposures gave iron capping rock, limestone, quartzite, black shale, porphyrite and normal granite. The original limestone (of Carboniferous age) was much uplifted and metamorphosed apparently by intrusions of granite and porphyritic dikes, bringing about a loss of color, (the bluish gray color being changed to white or whitish), a recrystallization and the formation of a variety of silicates, such as tremolite, tourmaline, and garnet, especially along the contact dikes, and a mineralizing of the dikes and the contact material. The final adjustment and mineralization probably occurred in the Tertiary. This formation is probably Archean or Algonkian in age, worked over from time to time during the Geologic ages. The principal mines of the region are located in this district.

Cambrian (Not mapped)

A quartzite series occurs as the base of the sedimentaries, a study of which was not made. Its position would seem to place it as of Cambrian age, probably of the Eureka stage. Ordovician rocks also seen to be present in a few exposures.

Silurian

Extending down the west face of the mountain range for about six miles from the northeast corner of the Deep Creek Indian Reservation is a narrow strip of limestone in which the writer found Halysites resembling Halysites Catenulata which seems to place this rock series as of Silurian in age.

Devonian

The Devonian system seems to be represented by about one thousand feet of white limestone.

Mississippian

In the Spring Creek region and southward are limestone exposures capped in places with very hard sandstone leaning toward a quartite, * * * * The strata are thick to rather thin bedded, and coarse grained in texture. At a few places intercalated beds of shale appear, while along the main ridge of the Deep Creek range the western fault forms great limestone bluffs; limestone conglomerate and chert pebbles are also prominent rock exposures. Shell beds are also occasionally conspicuous. The formation by comparison, seems to be the same as the limestone of the Canyon Range of west-central Utah which has been described by G. F. Laughlin[1] as "clearly of lower Mississippian or Madison facies", though the upper part is probably Pennsylvania and some of the lower strata pre-Mississsippian in age. The formation is probably three thousand seven hundred feet in thickness.

This formation is much broken, faulted, and fissured and possesses subterranean passages and extensive caves. Johnson Creek is swallowed up in one of these subterranean passages and likely comes out in the numerous springs below the range. Moreover, in the crevices and underground passages along the contact line between the quartzite and lime formation there are lodes of lead and lead-silver ore, as will be mentioned later.

Quartzite

Overlying the limestone above described, is a series of red to tawny quartzite abutting the granite ridge south of the Queen of Sheba mine, extending eastward to the foot of the mountain and southward as far as visited. The early geologist who visited the region believed the quartzite to be beneath the limestone formation and mapped it as middle and upper ordovican.[2]

But after going over the region and also comparing Mr. Laughlin's paper with reference to the quartzite of the Canyon Range[3] the author is led to believe that the quartzite under consideration is of upper Mississippian and Pennsylvanian age, to be correlated with the Weber quartzite. It is two hundred feet in thickness and a conspicuous rock wherever found .

Carboniferous - Undivided

In the curved mountain area near Trout Creek to the Nevada line and then down same about all the way to Wendover, thiry miles farther than our map shows, limestone and other sedimentary rocks are shown that appear to be of Carboniferous age, but no fossils

1 A Reconnaissance in the Canyon Range, West Central Utah, Professional Paper 90—F. P. P 53, 54.

2 See U. S. Geooligical Survey Professional Paper 71, Plate C, also see Spencer, Arthur C.: The Geology and Ore Deposits of Eli, Nevada; U. S. Geological Survey Professional Paper 96, pp 18-22; and Notes on Gold Hill and Vicinity, Tooele County, Western Utah, by J. F. Kemp and Paul Billingsley: Economic Geology, Vol. 13, 1918, pp 247-274.

3 Loc. Cit. pp 54, 55.

were obtained and their definite location in the carboniferous system was not determined. In appearance the series along the state line resembled the Aubrey of the Fort Apache region, Arizona. The formation is very thick.

Jurassic? (Not mapped)

Five hundred feet of black shales overlies the Carboniferous on the flanks of the mountain ridge at Clifton and Gold Hill, which are supposed to be of Jurassis in age, and Dr. J. P. Smith of Stanford University advises the writer that he has identified ammonite fossils from the Jurassic series in the upper Cherry Creek range.

Cretaceous (Not mapped)

One thousand feet of yellow shale and sandstone overlies the supposed Jurassic above and on strata-graphical grounds appears to be of Cretaceous in age. No fossils were obtained.

Tertiary and Later Effusive Rocks

Volcanic rocks were encountered about Ferber and northwest of Eight Mile Station (the latter not shown on the map) which upon examination appeared to be Tertiary in age.

Indian Mound on the reservation near the Nevada line also appears to be an extinct volcano of Tertiary age.

Tufaceous rhyolite of three hundred or more feet in thickness from the north, closing-in ridge of Deep Creek valley between it and the main Salt Lake basin, being also of Tertiary age.

Tertiary Deposits

The inner ancient lake region is composed of partly lithified sand and clay of a lightish color, some of it approaching the "mortar bed" formation of Kansas and Nebraska. The formation is probably hundreds of feet thick and ranges from the pliocene at the surface to probably eocene at base. The springs of the region, with few exceptions, come to the surface through this formation.

The broad, Deep Creek Quaternary valley is, in fact, flanked upon the west by low, gently sloping hills which in places rise one thousand feet above the valley and are six or seven miles wide and extend in a north and south direction for a distance of twenty-five miles. They are composed of white sand and marls, and a few rather fine to coarse conglomerates, occasionally carrying horizontal beds of rearranged sands and volcanic (rhyolitic) material, all of which at surface appear to be of pliocene age.

Bonneville

The Bonneville formation covers all the region north and east of the Deep Creek range. It is the formation mapped by Gilbert as Bonneville and is composed of unlithified sands and clays. The ancient lake beach shows very conspicuously everywhere. This formation extends over the low divide into the Deep Creek region at several places, the remains now being patchy. The formation is, of course, Quaternary.

Glacial?

A V-shaped area extending westward from Mount Ibapah and Bald Mountain to beyond Fifteen Mile Creek west of the Ghoshute Agency shows every evidence of glaciation. Beside the boulder clay, and conspicuous moraine material, the whole area is strewn over with striated boulders as big as common houses. The glacier seems to have determined the location of Fifteen Mile Creek.

The Bench - Quaternary (not mapped)

Toward the highlands the benches and foothills are covered with coarse sand and gravel. Also in the Johnson Creek and Spring Creek sections and south of the upper course of Fifteen Mile Creek, the whole region is covered with water worn cobbles. A well near the head of Spring Creek gave thirty feet of cobbles and did not reach through the deposit. Alluvial fans, consisting of heterogeneous masses of coarse sand, gravel, and cobbles, were also conspicuous near the mountains and about the mouths of the canyons. The thickness of the formation varies from a few inches to probably fifty feet.

The Valley Quaternary

The broad central floor of the ancient lake bed is covered with a few inches to a few feet of loam, often of the adobe type. In the valleys this deposit is composed chiefly of sand and clay loam varying from a few inches to fifty feet. Also in the lower section of the laked area the prevailing southwesterly winds have filled it up to a great thickness. It is quite probable that a part of the formation here is of the Bonneville stage.

Mineral Wealth

Some sixty years ago the Indians discovered ore of the lead-silver variety in the Deep Creek range and through not knowing its value showed the ore to some of the white settlers. A mining craze followed. The Queen of Sheba and Spring Creek districts were prospected, actual mining began, and about fifty running claims, all within the limits of the present Indian reservation, were patented. Ore was then found at Gold Hill and great excitement followed for a time. But as all the ore in the district was low grade the work was abandoned, on account of the increased cost of living and the long transportation across the Salt Lake Desert seventy miles to Wendover the Western Pacific. But the discovery of tungsten at Gold Hill and at Trout Creek gave a new impetus to mining interests. A million dollar railroad was then completed from Wendover to Gold Hill (Goodwin), and within a few months, from a single house (the post office) and a few mining shacks, a mining city sprang up and all was rush and bustle for a time. Then after the close of the war resulting in a slump in tungsten prices, the work declined; but ores of the arsenic sulphide class are being mined on a large scale.

The four principal mining districts are Queen of Sheba, Spring Creek, Trout Creek, and the Clifton Hill section, the first two being within the limits of the present Indian reservation. Following is a short description of each.

Queen of Sheba Mining District

This district is of interest as it lies within the limits of the Deep Creek reservation. It is situated at the head of Fifteen Mile Creek southeast of Ibapah Peak. In this region the following mining claims have been patented: the M. Merrill mine; the Queen of Sheba mine (two claims); and the Queen's Minister mine. The claims are contiguous and of similar formation.

The Queen of Sheba mine is the oldest mine and the only one which has had extensive development work done.

The original Queen of Sheba mine was opened up about thirty-five years ago. A Mr. Haven was the first man to work it. Mr. Rutledge, followed by Mr. Lauten, did development work and got out considerable gold. Messrs. Lauten and Palmer are the principal owners of the mine now.

The mouth of the original mine was eight hundred feet up the mountain side from the present mouth. The mineral, until the fall of 1914, was separated by the stamp-quicksilver system, the ore being of the free-milling variety. The stamp mill is one and one-half miles down the canyon from the mine. The old system had a tramway from the mine to a level fifteen hundred feet below in the canyon, and from there the ore was hauled to the mill with a wagon. The tramway proved too expensive. Also, it was believed that by driving a tunnel into the ore body at a lower level, better results could be obtained. As a result of this conclusion, a tunnel ten hundred and eighty feet in horizontal length and a three hundred and seventy-six feet raised-slant shaft was constructed in 1914 at a cost of twenty-five thousand dollars. A new road costing one thousand dollars was also made to the mouth of the tunnel, and over it the ore (fifty ton per day) was hauled to the mill. This made the hauling of the ore much cheaper than formerly and also gave better access to the ore body itself.

The first one thousand feet of the tunnel shows coarse grained granite, the rest quartzite to schistose-quartzite (Algonkian) wedged with intrusive granite dikes.

The ore vein has a trend of north sixty-three degrees and a dip of forty-three degrees nearly east. The vein is brown to gray quartz. It is of the free-milling gold variety. The width of the vein varies but averages from fourteen to twenty-five feet. The ore is low grade, containing from five to fourteen dollars in gold (or better), also some silver, lead, and antimony.

Mr. C. E. Johnson operated the mine in 1914 and 1915 with the aid of Mr. F. S. Sherman. But on account of the high prices and the long haul to Wendover, the mine was closed in the fall of 1915.

The Spring Hill Mining District

This district is also of interest as it is situated wholly within the boundaries of the Indian reservation. It lies on the east face of the Spring Creek spur of the Deep Creek range near the head of

Johnson Creek. Silver-lead ore was discovered about forty years ago and there was quite an excitement over the discovery. Some thirty claims were patented and several buildings, including a hotel, were erected. Then silver declined and the district was abandoned. Many of the claims are owned by Mr. M. Merrill; others by various parties. In 1915 Arthur Southerland and J. B. Thomas re-prospected the abandoned claims owned some thirty years formerly by S. S. Worthington of Grantville, (Utah), later by Gash Brothers of Ibapah, (Utah), making a rich strike. In doing assessment work on one of the old claims they encountered a body of pure galena ore. They shipped a car load of this ore which smelted twenty-four dollars of silver to the ton. Since then they have driven a one hundred foot tunnel into this vein and have also discovered other valuable croppings. The ore is in a fissure and blanket veins in Mississippian limestone along a contact between a quartzite ridge and the lime formation. Recently several carloads of low grade ore have been picked up as surface float in the vicinity. On account of the pocket nature of the ore, mining has not paid on the whole in this region.

Trout Creek Region

There are outcroppings at Willow Springs and in the vicinity of Trout Creek on the east flank of the Deep Creek range. The ore at Willow Springs is copper, silver, and lead; that at Trout Creek, fair grade tungsten.

The Clifton-Gold Hill District

This district, while off the reservation, is of interest in showing the minerals that may be found on the reservation at the other end of the same range of mountains; and also from the fact that the prospective value of these mines has brought the railroad forty-three miles nearer the Deep Creek reserve.

The minerals found here contain tungsten, copper, silver, lead, gold, and molydenum. The developed mines are: The Copperoplis, Seminole's Copper Company's property; the Glory Hole, the property of the Lucy L. Mining and Milling Company; Wilson Consilidated, property of the Woodman Mining Company; the Western Union, Gold Hill, Tripp-Southerland Copper Company's property; and the property of the Western Pacific Copper Company. The region bids fair to be one of the riich mining regions in Utah.[4]

Soil

It was the writer's intention to make a thorough study of the soil of the reservation to find out what crops would do best in the section. Pursuant with that intention he collected soil samples and sent them to the Bureau of Soils, Washington, D. C.

Sample number one was from the Stewart Ranch in the immediate Deep Creek Valley some four miles, a little to the east of south of the Ibapah P. O. It is surface creek-wash and is made up of both lime

4 The Gold Hill section is a rim of sedimentary rock, mainly limestone, surrounding an inner basin of granite.

gravel and sandstone and granite debris, pulverized by river action and the action of the air.

The depth of the soil ranges from two to ten or more feet.

Sample taken from the surface.

Specimen number two was taken from the center of School Farm of the Deep Creek Indian Day School to the west of Fifteen Mile Creek about three-fourth of a mile northwest of the school and agency. The specimen is weathered detritus from the mountains to the south which in the immediate vicinity, are mostly limestone, although some sandstone and granite are exposed. The formation appears to to be Mississippian in age.

Specimen number three was taken from Mr. Ike Lee's ranch on Johnson Creek, fifteen miles south of Ibapah P. O. It was secured on a bench near Mr. Lee's house to the east of Johnson Creek. The soil here appears, in the main, to be weathered Paleozoic rocks. It is about a foot thick of the consistency of clay.

Specimen number four was taken from four inches beneath the surface, (the thrown over part of a four inch furrow), one hundred feet northwest of the agency residence at the Deep Creek Indian School, twelve miles south of Ibapah P. O., Juab County, Utah. The soil is shallow, ranging from one foot to a few inches down to rock or hard-pan. This soil is from weathered granite of Archean age.

Specimen number five was taken from Annie's Tommy's Ranch in the bottom land just to the east of Fifteen Mile Creek and about one-half mile north of the Deep Creek Indian School at Indian Ranch some twelve miles south of Ibapah P. O. The specimen was taken from the surface and is composed, principally, of wash from the mountains. The mountains here are composed of Archean granite and such Paleozoic rocks as sandstone, limestone, quartzites, etc.

The analysis of these soils gives the following:

	Per cent of Oven Dried Soils				
Sample No. (on sacks)	K_2O	CaO	MgO	N (B. Chem)	P2O5
1	3.05	5.63	1.93	0.30	0.31
2	3.02	1.70	1.34	0.11	0.15
3	3.04	1.34	1.17	0.11	0.11
4	3.14	1.71	1.25	0.10	0.11
5	3.54	1.60	0.51	0.14	0.19

Bridge tests do not show alkali.

(1) Small amount of magnetite present. Quartz, biotite, and calcite are fairly plentiful. Muscovite is apparently less abundant than biotite. Plagioclases, hornblende, traces of spicules, some vegetable matter, traces of apatite, epidote, doubtful orthoclase and very doubtful gypsum are present.

2 Magnetite is present in larger quantities than in the preceding sample. Quartz, biotite, hornblende, calcite, muscovite, plagioclase, and microline are the common minerals present. Epidote occurs in traces. Vegetable matter and some spicules are noted. Apparently calcite is considerably less abundant in this than in the preceding sample.

(4) Magnetite is comparatively abundant. Quartz, orthoclase, plagioclase, hornblende, biotite, vegetable matter, rare spicules, rare zircon, muscovite, and rare rutite are present.

(3) Magnetite is present in about the same amount as sample number two. Quartz and biotite are the most abundant minerals present. Hornblende, epidote, muscovite, rutile, and orthoclase, occur in minor quantities. Some vegetable matter noted.

(5) Magnetite is present in about the same amount as sample number four. Quartz is the most abundant mineral present. Orthoclase, biotite, some isotropic material of doubtful nature, rutile, hornblende, zircon, plagioclase, epidote, vegetable matter, and a few spicule-like particles are present.

From the analysis it would appear that the soils are exceptional in potash, fairly rich in lime, but not exceptionally rich in other constituents. There appears to be no alkali in the soil and there is no apparent reason why it should not be of value for general farm crops if properly treated. In fact, the analysis shows that these soils are well supplied with the elements of plant food except nitrogen and humus. These may be furnished by proper irrigation and by the addition of barnyard manure or by growing and plowing under of green manure crops such as field peas, clover, alfalfa, or sweet clover, which has escaped from cultivation and grows everywhere in the region. This clover, though not used for a forage crop, grows luxuriantly, quickly, and produces an excellent yeield. Should it be plowed under as a fertilizer, it would enable the operator to add large quantities of humus forming material to the soil.

Water Supply

As will be seen by a later part of this article, the Indians are supposed to get one-third of the water of the various upper tributaries of Deep Creek. But much of this water is lost by underground seepage and drainage.

All the streams lessen as they descend from the mountains. Johnson Creek sinks in a hole in the west wall of the canyon about six miles above the agency and the waters of Deep Creek seldom reach much farther than Ibapah in the summer, being swallowed up, even at flood time, in the Salt Lake Desert.

Furthermore, the water which becomes under-ground drainage water in the upper country comes to the surface in springs in the lower districts. Johnson Creek undoubtedly comes out on the other side of Spring Creek ridge in the giant spring which is the source of Spring Creek. Also in the country still lower down there are nu-

merous springs. Moreover, the water in the well at Sheridan's store at Deep Creek comes within three feet of the top of the ground, and on the Bonamont ranch, some four miles farther north, there is a flowing well. It is the writer's opinion that artesian water could be obtained on the reservation in quantity for irrigating purposes, as is indicated by the springs. It is also quite probable that water could be stored in some sections.

Timber

There is a considerable timbered area in the upper mountain districts. Pine and balsam are the principal merchantable varieties. There are several million feet of this timber which is now mature. In fact, there are now over a million feet of dead and down timber on the reservation that should be taken care of at once. The government should put in a mill and have this timber sawed for use in building for the Indians, and for government use.

Antiquity

In the long ago this was an inhabited country. The cliff dwellers got this far north and here made their home for ages. What became of them can only be conjectured. But they left their writings on the rocks and on the walls of their homes to attest their having been here. A rock three-fourths of a mile east of the Deep Creek Indian Agency displyas their work. In the "basin" over Willow Springs Pass six miles to the eastward are numerous pictographs of this once dominant race. While at the head of Choke Cherry Creek in Nevada six miles southeast of the Indian Agency there are preserved the cliff house drawings of a happier day for the section.

Picture Cave

These pictures are exposed in a cliff cave. The cave is in a yellow limestone in a branch canyon on the west side of the upper headwaters of Choke Cherry Creek. The mouth of the cave faces the south, is forty feet long and ten feet high, but the roof pitches to the floor twenty feet inward. The drawings are on the back, upper wall. They are made of large, wide, heavy lines, blotches, and crude drawings in red, yellow, and blue—apparently of mineral paint. Besides these, the whole roof-face is run over in almost all directions by numerous black lines, drawn in a promiscuous manner and apparently without any design. The surface on which the drawings are made is much weathered and some of the pictographs can hardly be made out, or are entirely obliterated.

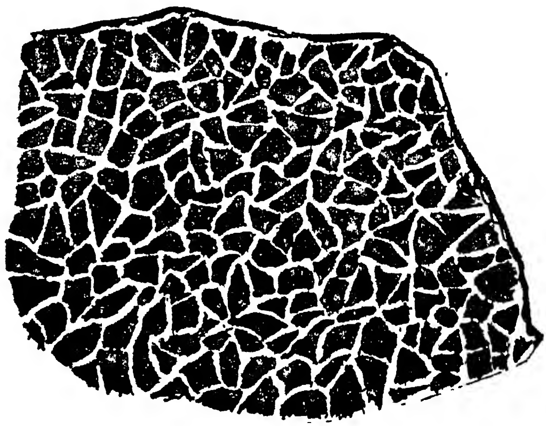
The Tradition about the Pictographs

When I asked the Deep Creek Indians about these pictures they gave me the following myth concerning them:

"The pictographs are in caves along Warm Creek, also in the canyons of the Deep Creek range, and in the hills toward Pleasant Valley. They were made by short, heavy-set giants of the long ago. The thunder bird preyed upon this people. Once my grandfather, (grandfather of the spokesman) you know my grandfather was a

medicine man, well, he had a dream to cure the sick. What he saw in his dream was his helper in driving the 'sick' out of people, his guiding spirit. At times when looking for his guiding spirit he would go out hunting in yonder (Ibapah Peak) mountains. Once while there fasting and praying he came along below a ridge on which the thunder bird had its nest. There he saw the bones of the little giants the great bird had discarded and thrown down from its nest after it had eaten all the flesh from them. The bones were many in number and very heavy.[5] These were the bones of the men who made the drawings in the caves and along the canyon walls."

5 It is probable that the petrified bones of some prehistoric animal may be exposed in some of the hills of these mountains and were seen by the medicineman.



HALYSITES CATENULATA?

From Silurian limestone about six miles northeast of the Agency office on the Deep Creek reservation, near Ibapah, Utah.—Drawing by Grover Clover, a pupil of the Deep Creek Indian School.

BOTANICAL NOTES 1921-1928

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(Note: This paper is the assembly of papers No. 6 of 1922, No. 20 of 1923, No. 8 of 1924, No. 16 of 1925, No. 2 of 1926, No. 7 of 1927 and No. 5 of 1928, each paper reporting for the year previous.)

Seasonal Activities of Certain Plants 1921

As in previous reports, unless otherwise stated, the date will signify the plant to be in bloom.

Pinus austriaca Hoss. Oct. 8, buds nearly two inches long. Oct. 18, are lengthening yet.

Picea pungens Engelm. Sept. 7. Young needles showing.

Tripacum dactyloides L. Nov. 7, blooming.

Erythronium mesochoreum Knerr. March 5; 8.

Asparagus officinalis L. Aug. 26, shooting. Oct. 6; 8.

Iris verna L. March 17

Ulmus americana L. Mar. 1. largely past blooming.

Delphinium ajacis L. Aug. 1, old plants; new from this year's seed; Oct. 30; Nov. 8, collected a bouquet, cold wave coming, Nov. 18.

Podophyllum peltatum L. April 30, flowers very scarce (plants frozen enough to kill most of the flowers.)

Lepidium virginicum L. June 14, 26; July 21; Aug. 8, 26.

Capsella bursa-pastoris (L.) Medic. June 26; Oct. 30.

Raphanus sativus L. Mar. 5, out of ground several days before this. Nov. 8, blooming.

Spiraea van Houttii (S. trilobata Linn., improved variety), June 26; Aug. 6, 26; Sept. 7, twenty-two clusters; Oct. 11, 16, 25, 30, Nov. 8.

Pyrus communis L. June 17; May 27; July 5; Oct. 8; Nov. 5. By Homer A. Stephens.

Pyrus baccata L. June 14. (Stephens).

Pyrus malus L. June 8, 17, Oct. 5; all previous to this by Stephens. Hillsdale, Oct. 23, reported by Dwight Phillips.

Pyrus japonica Thunb. May 27.

Crataegus mollis (T & G) Scheele. May 16.

Fragaria virginiana Duchesne, var. illinoensis (Prince)) Gray. Mar. 25, 27, 28, 29; (Cold, 18 above in the forenoon of Mar. 28.) (These were cultivated plants.)

Rubus occidentalis L. May 13; budding anew June 11; blooms and ripe fruit June 26.

Rubus allegheniensis Porter. June 11, ripe and blooming; June 14.

Rosa multiflora Thunb. (Dorothy Perkins Rambler). May 13, budding anew after freezing.

Prunus americana Marsh. Mar. 6.

Prunus persica (L.) Stokes. Mar. 6.

Prunus armeniaca L. Mar. 5.

Cercis canadensis L. Apr. 30, May 16.

Melilotus offincinalis (L.) Lam. Aug. 13.

Pisum sativum L. Mar. 5, coming through the ground.

Oxalis corniculata L. Nov. 19, buds.

Acer saccharinum L. Mar. 1, largely through blooming.

Vitus labrusca L. June 2 new blooming, July 11, new, (Concords previous to this.) Sept. 28, ripe fruit on caco, Nov. 11, half grown Caco.

Tamarix gallica L. July 29.

Viola papilionacea Pursh. Mar. 18, 19, May 8, 15, Sept. 27.

Oenothera biennis L. Oct. 11.

Oenothera speciosa Nutt. Aug. 1, old plants, Aug. 5, Sept. 5, two bunches (Homer Stephens).

Forsythia viridissima Lindl. Mar. 1, beginning to bloom, Mar. 5, full bloom.

Syringa vulgaris L. Oct. 5, full bloom, (Stephens).

Phlox divaricata L. Apr. 30, abundant.

Verbena canadensis L. Mar. 18, Apr. 30.

Petunia violacea Lindl. Nov. 8. Cold wave here.

Antirrhinum majus L. Mar. 5, last year's plant still alive.

Diervilla florida Sieb. & Zucc. June 2, 8.

Viburnum opulus sterilis. May 13, largely new ones, June 2, 8, 14, 23; new balls 26; blooming well July 1, 6; new ball 16, 26, Sept. 7, 27, Oct. 2, 3, some new ones coming 11, Nov. 9, new, 18. July 5. (Stephens).

Sambucus canadensis L. July 29, Aug. 1.

Erigeron ramosus (Walt.) BSP. Aug. 13, 17, Oct. 30.

Lepachys columnaris (Sims) T. & G. Sept. 20, Oct. 14.

Taraxacum officinalis Weber. Mar. 1, Oct. 30. The winter of 1921-1922 has been the worst for this plant that I have observed. The specimens noted are badly browned with no sign of life above ground.

Lactuca sativa L. Mar. 5, coming through the ground.

Polycotyledony in 1921

Out of 428 seeds of previous dicotyledonous plants of Lycopersicon esculentum Mill. but 5 were tricotyledonous, or just over 1 per cent. Two of these are alive in pots.

In the case of Ricinus communis L., we had seven hundred and seventy-six dicots from tricot seed of the previous year, and eight tricots. The ration here is a little better than one per cent as in the tomato above. We raised seed from seven of these plants this season and have kept separate seed of each in the hopes that there may be some difference in the individuals. The previous ratio was about twenty to one, and of course, indicates a slump in the ratio. We are still interested in the Castor Bean also and expect to continue the test with it.

Unusual Seasonal Activities of Certain Plants, 1922

When only the date is given, it is understood that the plant is blooming. As before the data is that of the author unless specifically stated to the contrary. Mr. Homer Stephens noted several items and is credited as "H. S.". Most of the facts have been noted in or near Emporia.

Hyacinthus orientalis. Jan 20, 1923.

Ornithogalum umbellatum L. Shows plainly above ground Jan. 20. 1923.

Iris germanica, var. July 26.

Delphinium ajacis L. Aug. 11, (continuing since early spring), Oct. 25 and 29, Nov. 12, (from seed of 1922 plants), Nov. 12, (old plant, perennial plant).

Spiraea trilobata L. (Spiraea van Houttei). July 5, 16, 26, Aug. 11, 14, 26, 31, Nov. 26 (numerous flowers out.)

Pyrus communis L. June 3. "H. S."

Pyrus malus L. June 2, "H. S.", Oct. 16, (Topeka, Edith Moore reported).

Chaenomeles lagenaria. Jan. 19, 1923, (inside of buds showing but no color).

Pyrus prunifolia Willd. (?). Oct. 16, (Topeka, Edith Moore).

Rosa humilis Marsh ?) July 14.

Rosa sp. Jan. 20, 1923, buds swelling on the cultivated roses.

Prunus sp. (Cultivated Cherry), Oct. 16.

Trifolium repens L. Nov. 12.

Melilotus officinalis (L.) Lam. Aug. 6, (many), Nov. 12.

Medicago lupulina L. Sept. 25.

Robinia pseudo-acacia L. July 14, "H. S.", 21, "H. S.".

Linum sulcatum Riddell (?) Sept. 25.

Oxalis violacaea L. June 28.

Acer saccharinum L. Feb. 22, 1922.

Vitis sp. (Cultivated), Aug. 19.

Tamarix gallica L. (?), Aug. 1.

Viola cucullata Ait. Oct. 29.

Viola sp. (Sweet Violet). Jan. 20, (1923, flowers withered somewhat.)

Oenothera speciosa Nutt. July 16, 22, 30, Aug. 7, "H. S.", 14, 20, 24 "H. S.".

Syringa vulgaris L. Oct. 14, "H. S.".

Phlox divaricata L. July 8.

Diervilla florida Sieb. & Zucc. July 26, Aug. 1, 11.

Lonicera sp. (Climbing). Sept. 4, (Blue Mound).

Erigeron ramosus (Walt.) BSP. July 8.

Taraxacum officinale Jan. 5, "H. S.". This plant is likely to have flowers and fruits on it any month in the year. It is ready to bloom whenever the weather may be favorable. It has, however, a time of principal blooming. We have noted that the English sparrow uses the akenes for food at times.

Polycotyledony of Lycopersicum esculentum Mill. and Ricinus communis L.

We have no advance to report in the tomato. We kept two plants alive over winter and secured a plentiful supply of seed from them. We expect to test this further the coming season. We kept them over as we had not secured any seed from them the season they were planted.

We can report what may be progress with the Castor Bean. Beginning with the season of 1921 we kept the seed of each tricot plant separate. We expect to follow this plan henceforth. We had saved seven plants that season. We planted some seed of each of these plants this season with the following results:

No. 1. 124 plants, 10 tricots, 8.06 per cent; No. 2. 119 plants, 5 tricots, 4.20 per cent; No. 3. 103 plants, 5 tricots, 4.85 per cent: No. 4 92 plants, 6 tricots, 6.52 per cent; No. 5. 106 plants, 3 tricots, 2.83 per cent; No. 6. 65 plants, 4 tricots, 6.15 per cent; No. 7. 103 plants, 1 tricot, 0.97 per cent. A total of 712 plants, 34 tricots, average 4.77 per cent. Ratio of tricots in No. 7 to those in No. 1 is 1 to 8.3.

From the above figures it seems evident that some individual tricots can be expected to yield a higher proportion of tricots than others.

With this in mind seven plants from No. 1 and six from No. 4 were transplanted and raised in two groups. Seed was collected from each of these and preserved for the coming season.

A Girdled Currant Stem

While trimming some currant bushes on November the eleventh, I noticed that one stem that I had cut off had been girdled at some earlier time and notwithstanding this fact was still a vigorous specimen. From its appearance it was apparently well on its way toward connecting up the two bark areas. The only plausible explanation of its continued vigor seems to be that underground connections were supplying the roots of this particular part and thus keeping them at work efficiently.

A Weed with Spirally Coiled Roots

On January 28th, 1923, I ran across the stump of a weed in some drift along the Neosho river. For some reason unknown to me some of the roots have formed a close-fitting spiral. Other roots have apparently grown normally.

Items for the Bird Calendar

February 22, 1922, saw and heard some robins. February 23, 1922, heard robins, a redbird and a chickadee. Temperature 14 degrees. January 16, 1923, robins calling. (Have probably wintered with us.) January 30, 1923, robin singing its spring song. January 31, 1923, two robins singing their spring song. February 2, 1923, robin singing spring song; cold wave coming. February 5, 1923, saw and heard a blue jay on the Normal campus. February 8, 1923, Homer Stephens saw two bluebirds along the Neosho.

Butterfly Note

On January 15, 1923, I saw a yellow butterfly on the ground which apparently had but recently emerged from its chrysalis. It could not fly as its wings were not well expanded. It was seemingly related to the cabbage butterfly.

A Sparrow's Nemesis

On February 20, 1922, while out with a class, we found a sparrow that had been caught in a strand of horsehair and had died as a result. The hair was a part of an oriole's nest. We presume that the sparrow had been in search of materials for a nest when it became entangled. It had evidently been dead for a considerable time. We still have the nest and the bird.

Unusual Seasonal Activities of Certain Plants, 1923-1924

As before, the dates given indicate time of blooming, unless otherwise stated.

Tradescantia sp. July 29.

Erythronium mesochoreum Knerr. March 24, 1923, Mar. 2, 1924. (Some blossoms nearly out on plants that were in shallow soil on a bank exposed to the south.)

Oxybaphus sp. Sept. 20.

Cerastium brachypodum (Engelm.) Robinson. Mar. 24, 1923.

Delphinium sp. Perennial. Nov. 24, (frozen now), Dec. 1, many buds.

Capsella bursa-pastoris (L.) Medic. Mar. 9, 1923, 23, 1923.

Brassica nigra (L.) Koch. Nov. 25, Dec. 25.

Philadelphus coronarius L. Jun. 23, July 3, Aug. 13.

Spiraea trilobata L. (S. van Houtti). July 3, Sept. 15, Oct. 3, 5, 13.

Pyrus communis L. Tonganoxie, Kansas), Oct. 12, Nov. 12, Dec. 3. (Faded flowers.)

Fragaria sp. Cultivated, Tonganoxie), Dec. 31, flowers and small fruit.

Rosa sp. (Dorothy Perkins?) Oct. 26, Dec. 27, (sp.?), (Perfect bud, Tonganoxie.)

Acer saccharinum L. Mar. 3, 1923, Dec. 3, in leaf N. of Lawrence.

Vitis sp. (cultivated), July 24.

Tamarix gallica L. July 29, Aug. 4.

Viola papilionacea Pursh. Oct. 26, Nov. 8.

Oenothera speciosa Nutt. Aug. 24.

Asclepidora viridis (Walt.) Gray. Aug. 14, advanced buds.

Veronica sp. (Wild plant.) Sept. 6.

Diervilla florida Sieb. & Zucc. July 22, 29, Oct. 26.

Viburnum opulus sterilis. July 22, 29.

Taraxacum officinale Weber. Nov. 8, 12, Dec. 1, 15, 16.

Polycotyledony in Castor Beans, 1923

We planted seed from thirteen different plants of the crop of 1922. The usual number was about one hundred. All of the dicots among these were pulled and at the same time a record made of them The

tricots and 4-cots were carefully noted and recorded and the percentages also calculated. From the most promising test rows plants were chosen and transplanted to places as far apart as our grounds permit. This included at least one of the 4-cots. Seed has been saved for this year's planting.

Very unfortunately all of our data was lost except the names of those plants kept. From recollection only we can say that the results were about as variable as in our last report, or about two per cent to ten per cent of polycots from the various plants. We do not recollect of finding "fours" before. These appear to be simple twins. We may be wrong. We promise greater care this year not to lose our data.

Miscellaneous Notes, 1923

We found a gladiolus, Kunderdii Glory, with four stamens. An iris with all of the parts in fours was picked June 6th. We did not note this when we picked it and so cannot tell what plant produced it. We hope to watch for it this season.

In class work this spring the pupils found an elm and a maple flower with three carpels each. I have preserved them.

We have a wild phlox, Phlox divaricata L., at our home that regularly produces white flowers. I found a specimen of prairie violet, Viola pedatifida G. Don., last spring and removed it to our garden and hope to do something with it. It is apparently living.

A pupil, Homer Stephens, found a white specimen of Liatris squarrosa Willd.?. He has the plant located but we have not transferred it. We wish to follow up all of the above plants for further notice.

Unusual Seasonal Activities, 1924

Judging from accounts in the newspapers this has been probably more than usually a year of unusual seasonal activities. A few of the following items have been from newspaper sources. The major portion, however, are from our own observation at Emporia, Kansas. The method of reporting follows that of previous years.

Tradescantia virginica L. Aug. 3, 19, 20, 23, 24, Sept. 2.

Erythronium mesochoreum Knerr. Mar. 8, 1925.

Gladiolus sp. June 24.

Aquilegia canadensia L. July 17, 19, 25.

Delphinium ajacis L. From new plants. Aug. 28, Oct. 29, Nov. 6.

Delphinium cheilanthum Fischer (?). Oct. 28, 29, Nov. 16, 26, 29.

Escholtzia californica Cham. Nov. 23.

Lepidum virginicum L. July 17, 25, Oct. 11.

Philadelphus coronarius Linn. June 19.

Philadelphus sp. Fragrant. Aug. 20, 21.

Spiraea van Houttei. June 19, 26, July 5, 15, 19, 25, Aug. 3, 17, 21, 24, 28, Sept. 3, 5, 12, 15, Oct. 4, 11.

Pyrus baccata L.(?). May 17, June 4.

Pyrus malus L. Nov. 12. Near Cottonwood falls.

Chaenomeles lagenaria. Nov. 13, Dec. 10.

Fragaria chiloensis Duchesne. (Senator Dunlap.) Nov. 19, 23.

Rubus villosus Ait. July 19, Aug. 12, Sept. 4, Ripe fruit and others ripening and more buds.

Prunus cerasus L. Oct. 4. In Strong City. Nov. 12, near Cottonwood Falls.

Malilotus officinalis (L.) Lam. Aug. 17.

Melilotus alba Lam. Oct. 3, 4.

Trifolium repens L. Oct. 14, Nov. 10.

Vitis labrusca L. Oct. 28; second crop of grapes, Wooster's Mound.

Sida spinosa L. Oct. 28.

Viola papilionacea Pursh. Dec. 12; wild plants.

Viola odorata L. Mar. 7, 1925.

Oenothera speciosa Nutt. July 24, 27, Aug. 16, Sept. 15, 18.

Phlox paniculata L. Aug. 21.

Phlox divaricata L. (White form.) Oct. 3.

Phlox sublata L. ("Pinks.") Aug. 23.

Antirrhinum majus L. Nov. 23.

Diervilla florida Sieb. & Zucc. July 7, Aug. 3, 7, 17, 21, 24, Sept. 5, 12

Lonicera tartarica L. Sept. 3, 5.

Viburnum opulus sterilis. July 15, 25, 27, Sept. 15, 19, 23, 28, Oct. 4.

Sambucus canadensis L. July 25, 27, Aug. 3.

Lepachys columnaris (Sims) T. & G. Sept. 18, Oct. 21.

Zinnia elegans Jacq.(?) Nov. 10.

Gaillardia aristata Pursh. (Cult.) Nov. 13.

Taraxacum officinale Weber. All summer and practically every month. Nov. 10.

Polycotyledony in the Castor Bean, 1924

Seed from six plants (all tricots) of the season 1923 gave the following results when planted the spring of 1924: No. 23A. 131 dicots, 7 tricots, 5.34 per cent. No. 23B. 41 dicots, 2 tricots, 4.87 per cent. No. 23C. 94 dicots, 4 tricots, 4.25 per cent. No. 23D. 112 dicots, 4 tricots, 3.57 per cent. No. 23E. 131 dicots, 2 tricots, 1.51 per cent. No. 23F. 124 dicots, 5 tricots, 4.03 per cent. Total 633 dicots, 25 tricots, 3.94 per cent.

The highest per cent of tricots was in No. 23A. Five tricots from this group were selected, transplanted, and seed from them saved for this year. All other plants were destroyed.

I noticed this year an apparent grouping of the tricots in the rows of test seeds. It struck me that possibly the three seeds from a single capsule might all be alike, whether dicots or tricots.

Seasonal Notes, 1925

Tradescantia sp. July 13, 15.

Erythronium mesochoreum Knerr. Feb. 24, 1926.

Scilla sibirica Anders. Feb. 24, 1926.

Gladiolus sp. June 14.

Ulmus americana L. Flowers well advanced Feb. 24, 1926.

Morus rubra L. Fruit on this tree Aug. 31.
Eranthis hyemalis (L.) Salisb. Feb. 1926.
Aquilegia canadensis L. Aug. 10, Sept. 3.
Delphinium ajacis L. Sept. 3.
Lepidium virginicum L. Sept. 3.
Capsella bursa-pastoris (L) Medic. Mar. 4, 1926.
Philadelphus virginalis. July 22, 25.
Spiraea trilobata L. var. van Houttei. May 27, June 7, 15, 18, Sept. 3.
Pyrus malus L. Oct. 19, had been in bloom a few days before this.
Rubus villosus Ait. Fruit still ripening Aug. 5, 12. Green berries and ripe fruit Aug. 12.
Prunus sp. (Cherry) Oct. 19. See Pyrus malus above.
Prunus sp. (Plums) Oct. 19. See Pyrus malus above.
Lespedeza sieboldi Miq. Aug. 7.
Acer saccharinum L. Pistillate flowers in full bloom Feb. 14, 1926.
Althaea rosea Sept. 23.
Viola odorata L. Dec. 19.
Viola rafinesquii. Mar. 9, 1926.
Oenothera sp. July 21. Aug. 2, Sept. 12.
Phlox divaricata L. June 2, 7.
Diervilla florida Sieb. & Zucc. June 13, 15, July 25, Aug. 2, 24.
Lonicera tatarica L. June 15, July 8, Sept. 6.
Viburnum opulis sterilis L. June 28, July 13, 22, 25, Aug. 2.
Sambucus canadensis L. Aug. 16.
Taraxcum officinale Weber. Dec. 25, Mar. 1, 1926. And at many times other than the regular spring blooming time. It may sometimes be found blooming in every month of the year.

Polycotyledony in the Castor Bean, 1925

We have been carrying on the study of this condition as before but with no further light on the cause of it. We judge that greater care in the pollination will be necessary before satisfactory results can be reached.

Laciniated Petals in Phlox divaricata L.

Mr. Homer Stephens found a specimen of Phlox divaricata L. growing wild that has laciniated petals. We have it growing in our garden.

White Forms of Flowers Usually Colored Differently.

We have growing a white form of Phlox divaricata L. and another plant of a white form of the prairie violet, Viola pedatifida G. Don. A white specimen of Liatris sp. has been observed on the prairies near Emporia.

Polycarpy in Acer and Acarpous Flowers in Prunis

A student observed a pistillate flower in Acer saccharinum L. this spring that had three carpels instead of the usual two. In studying some wild plum flowers last spring (1925), many flowers were found that apparently had never possessed any carpels whatsoever. This may be a common occurence but we never noted it before.

Plant Activities Out of Season, 1926

Tradescantia bracteata Small (?) July 27, 29, 31, Aug. 1, 25, 26, 29, 30, Sept. 1, 4, 7, 11, 16, 25, Oct. 4, 9, 10, 14; 16; 20; 23.

Asparagus officinalis L. Sept. 16, flowers and new shoots; 25.

Crocus susianus Ker. (?) Feb. 25, 1927.

Aquilegia canadensis L. June 30, July 13, 18, 22.

Dicentra spectabilis DC. June 30.

Lepidium virginicum L. Oct. 14.

Lepidium apetalum Willd. Oct. 14.

Capsella bursa-pastoris (L.) Medic. Oct. 23, Nov. 8, Feb. 3, 1927, 16.

Philadelphus coronarius L. var. virginalis. July 15, Aug. 21, 23, Sept. 1, 4, Oct. 1, 6, 9, 10, 14, 20, Nov. 2.

Spirea van Houttii (S. trilobata Linn.) June 27, Aug. 23, Sept. 10, 11, 16, 25, 27, Oct. 6, 9, 14.

Pyrus malus L. May 22, Nov. ? (Flowers and fruit in Austria newspaper report.)

Pyrus bacata L. June 2.

Rosa sp. Nov. 2.

Rosa hugonis. June 9 .

Prunus sp. (Plum) (Near Strong City) Sept. 24.

Melilotus offcinalis (L.) Lam. Oct. 16.

Melilotus alba Desr. Oct. 31. (Great Bend.)

Acer saccharinum L. (Pistillate). Feb. 7, 1927.

Acer saccharinum L. (Staminate) Feb. 16, 1927, abundant and bees numerous on them.

Tamarix odessana. Sept. 30.

Vitis labrusca Linn. (Concord). Oct. 1. (Second crop of fruit.)

Viola papilionacea Pursh. Oct. 23. Nov. 6.

Oenothera speciosa Nutt. June 27, 30. July 13, 15, 22, 27, 29, Aug. 1.

Syringa vulgaris L. Sept. 27. (In full bloom.)

Asclepiodora viridis (Walt.) Gray. Aug. 1.

Phlox divaricata L. June 27.

Diervilla florida (Sieb. & Zucc.) Aug. 23, 25, 29, 30, Sept. 1, 4, 11, 16, Oct. 1, 9, 31. (Great Bend.)

Tartarian honeysuckle (Lonicera tatarica Linn.) Sept. 7, Oct. 23, (Fruit.)

Viburnum opulis sterilis. Nov. 2, 3.

Erigeron ramosus (Walt.) BSP. Oct. 23, Nov. 3.

Helianthus petiolaris Nutt. (?) Oct. 31. (Great Bend.)

Achillea millefolium L. Nov. 7. (Near Reading).

Taraxacum officinale Weber. Oct. 24, Nov. 23, Dec. 3, (abundant) Dec. 19.

Miscellaneous Notes, 1926

During and following our attendance at the 1926 meeting of the Academy at Winfield, we observed a great abundance of the pansy violet, Viola rafinesquii Greene. in blossom. Portions of the prairie were distinctly covered with them. This was true both at Winfield and near Emporia and between the two towns near the Santa Fe

railway. The same violet is to be found in similar numbers this spring, 1927, near Emporia.

Houstonia minima Beck., a form of bluets, or innocence, to be found in countless numbers in the Stannard pasture adjoining Emporia on the northwest. Altho possessing a tiny flower, the total effect is quite noticeable for ten or more rods from the observer. We have never observed this condition with this flower previously.

A freak pumpkin was observed by Mr. J. M. Shoop in his garden in September, 1926. There were no external openings in it, but in the natural cavity there was a stem with two green leaves on it. The pumpkin was about ten inches in external diameter.

A pupil of mine discovered an anomaly in the common wild blue sage, Salvia pitcheri Torr. The peculiarity was in the color of the corolla which was white instead of the usual blue of this flower. It was found on Perley's Hill in the outskirts of Emporia, September 23, 1926.

On June 3, 1926, a flower of Iris germanica L., was found with the flower formula in the two flowers of 2-2-2-2 instead of the normal 3-3-3-3. We previously reported it with the formula 4-4-4-4.

Unusual Seasonal Activities of Certain Plants, 1927.

Unless otherwise specified these notes refer to observations made in or in the vicinity of Emporia, Kansas. The list includes plants blooming at unusual times unless differently stated.

Avena sativa L. Second crop, near Elmdale, 5 to 10 bushels per acre. Nov. 12.

Bouteloua curtipendula (Mx.) Torr. Near Newton, Oct. 14.

Tradescantia sp. July 7, 23, 27, Aug. 3, 14, 18, 27, Sept. 1, 6, Oct. 1, 8, 13, 19 (many), Nov. 2.

Asparagus officinalis L. New shoots Aug. 19, Sept. 22.

Gladiolus sp. Oct. 22.

Mirabilis jalapa. July 27, Oct. 22.

Lepidum virginicum L. July 27, Oct. 21.

Delphinium ajacis L. Aug. 27, Oct. 22, Nov. 24.

Capsella bursa-pastoris (L.) Medic. Aug. 26, flowers and fruiting Nov. 24, (Near Burlingame), 27.

Philadelphus virginalis. July 14, 23, Aug. 3, 14, 20, 27, Oct. 27, Nov. 2.

Spiraea trilobata L. var. van houttei. Apr. 27, June 13, 30, July 3, 10, 14, 17, 23, Aug. 14, 18, Sept. 6, 17, Oct. 1, 22.

Spiraea prunifolia Sieb. Nov. 2, 10, 24.

Pyrus malus L. Oct. 1, In Chase County, second crop as large as plums. Nov. 12, second crop of apples used for cooking near Elmdale.

Fragaria sp. (Cult.) Aug. 15, 19, 26 (Dunlaps), 27 (flower and one ripe fruit.)

Rubus sp. (Cult.) Aug. 25 (two ripe berries.)

Rosa sp. (Cult.) H. P. July 12, Aug. 21, Sept. 30.

Rosa humilis Marsh. June 30.

Rosa sp. (Conrad F. Meyer ?). H. P. July 4, 10, Oct. 22.
Rosa sp. (white climber). Nov. 12.
Prunus persica (L.) Stokes, var.?. Oklahoma, (K C Star), Aug. 28.
Prunus sp. (Cult.) Newton and between Newton and Emporia, October 16.
Lespedeza sp. (Cult.) Aug. 14, and before.
Callirrhoe involucrata (T. & G.) Gray. Newton, Oct. 14.
Tamarix gallica L. (?). July 17, 23, Aug. 14, 18.
Viola odorata Linn. Nov. 10, 24, Oct. 22.
Oenothera speciosa Nutt. Sept. 9, (reported by Homer Stephens, 22.
Cornus asperifolia Michx. October 6.
Forsythia viridissima Lindl. Sept. 3.
Ipomoea batatas Lam. Oct. 1, (unusual). Reported by Daniel Simkins west of Reading.
Ipomoea quamoclit L. Oct. 14, (Newton.)
Phlox sp. Oct. 22.
Verbena bipinnatifida (L.) Britton (?). Oct. 22.
Petunia violacea Lindl. Oct. 22.
Solanum tuberosum Linn. Many new tubers Oct. 12.
Lycopersicon esculentum Mill. July 27, Oct. 22.
Catalpa sp. July 3.
Diervilla florida Sieb. & Zucc. July 17, 23, Aug. 3, 18, 27, 28.
Lonicera tatarica L.
Viburnum opulis sterilis L. July 14, 17, 23, Aug. 14, Sept. 2.
Sambucus racemosa L. var. laciniata Koch. Sept. 22.
Liatris punctata. Oct. 14. (Newton).
Solidago sp. June 30, Oct. 23.
Erigeron ramosus (Walt.) B.S.P. (?) Oct. 23, 30, Nov. 10.
Lepachys columnaris (Sims) T. & G. Sept. 22.
Helianthus annuus L. July 12.
Coreopsis tinctoria Nutt. Oct. 13, second crop from seed.
Centaurea cyanus L. June 30.
Taraxacum officinale Weber. Abundant Sept. 6, Nov. 10. 24.

Mutant of Helianthus

The fall of 1927 we observed a form of what appeared to be Helianthus maximiliani Schrad. growing in fair abundance in a place by a roadside northeast of Emporia several miles. The main difference noted is that this plant has flowers of a sulphur yellow instead of the usual sunflower yellow. It was distributed for several rods along the road, indicating that it has been there for several years at least, it is perennial, and that the mutation, if it be such, is coming quite true to seed.

Some Notes on the Papaw, Asimina triloba Dunal

A statement in a recent number of The American Forestry Magazine concerning the papaw aroused my interest as I had known our form for much of my lifetime. Below I have related two instances of unusual and striking effects.

One gentleman, an acquaintance of mine, when a boy, was instructed by his mother to cross the Cottonwood river at his home southwest of Emporia, and secure some ripe papaws. This was done and the family ate enough to satisfy them. His mother then instructed him to dispose of the rest, something like a half bushel, in order not to have them as a nuisance about the house. My friend very innocently threw them into the hog lot containing from twenty to thirty shotes of about one hundred and fifty pounds weight. These were being dry fed. This was done shortly before dinner. About one and one-half hours afterward the father and son were at the feed lot and the father, very much to his surprise, noticed something wrong with some of the shotes. On examination six of the animals were found to be dead. According to my friend's recollection, none of the others were affected. In explanation of the matter it was noted that the animals were hungry for something of a green nature and had eaten the fruit with avidity, seeds and all. This gentleman thinks that there can be no doubt that the hogs were killed by the papaws.

During the papaw season of the fall of 1924, a young man, a student at the Teachers' college ate probably less than one-half of a moderately sized specimen. This was in the afternoon of a certain day. About nine p. m. of the same day his lips began to curl outward and swell. Before long his eyes were swollen and soon closed entirely. He suffered considerable pain especially about the head. This was accompanied by a throbbing of the whole body. The physician attending him prescribed sponging with water containing soda. He also gave him an ointment to use. This attack lasted about two days. His attendant said that he acted delirious at times during the attack.

It happens in this case that the young man is very sure that the papaws caused the condition as he had suffered a former and possibly more severe attack some years before.

The physician is of the opinion that it is a form of protein poisoning in the intestines.

A STUDY IN PSYCHOGRAPHS

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Seventy psyographs were worked out, two of which are here presented, as illustrative material.

The purpose of psychographs was to show, graphically, the intelligence rating of seventy students, as revealed by certain intelligence tests.

The school used was a private, denominational school of junior college rank that was not meeting the college requirements as to scholarship.

The conditions of the school were such that one of several causes might be to blame for this lack, and would bear investigation. All of the following were studied, more or less carefully. The findings of the tests alone are here presented in the belief that they best reveal the causes of the low academic standing.

Causes Found

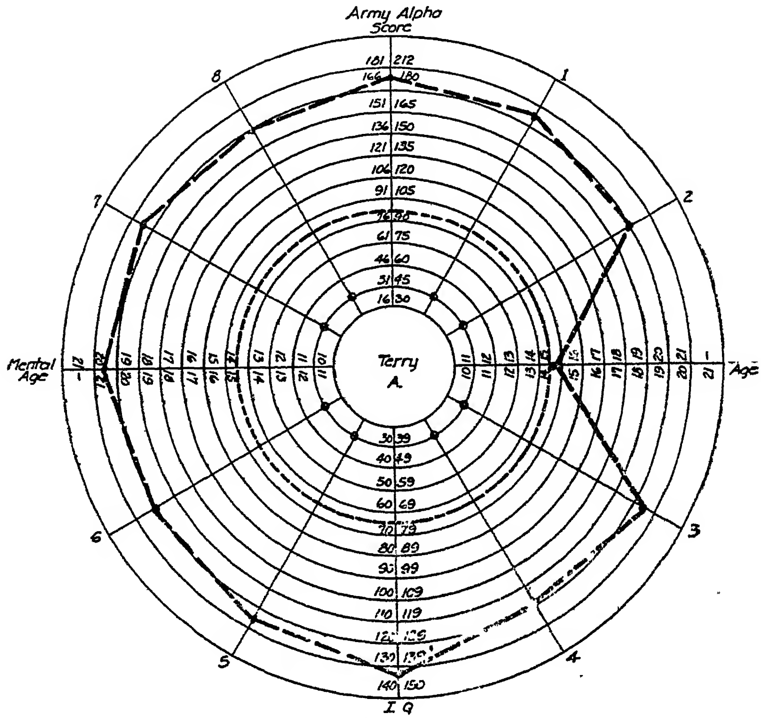
1. The wide range of ages in the classes.
2. The overage of many students.
3. The previous schooling.
4. The fact that many work a year or two, every once in a while, to get money to be able to go to school.
5. The homes from which the students come.
6. The general intelligence of the students.

The tests used were (a) the Otis at the first of the year, (b) the Terman in the mid-year and (c) the Army Alpha at the close of the year.

Graphs of all kinds were built from the findings of these tests that were used by the president of the college in reclassifying the students. The ones that seemed to show the most and that appealed to the students as mental pictures of themselves, were the psychographs, two of which are here used.

The scores obtained from the Army Alpha Tests were ranked as in the army: A—135-212; B—105-134; C—75-104; D—45-74; E—25-44.

The intelligence quotients (I. Q's) were worked out by a table found in the manual which considers the chronological age up to 21 years. In this way, score for score the older students have lower I. Q's with this test than with the Terman Test and the Otis Test. Hence, for significance in diagnosis, the scores are considered for the older students rather than the I. Q's. In the middle range the I. Q's are fair indices of intelligence and are comparable to those obtained by the Terman Tests; indeed, in over 25 per cent of the cases the I. Q's were identical or varied only a point or two. The estimates the faculty placed on these students and their regular class standing also agreed with the finding of the tests.



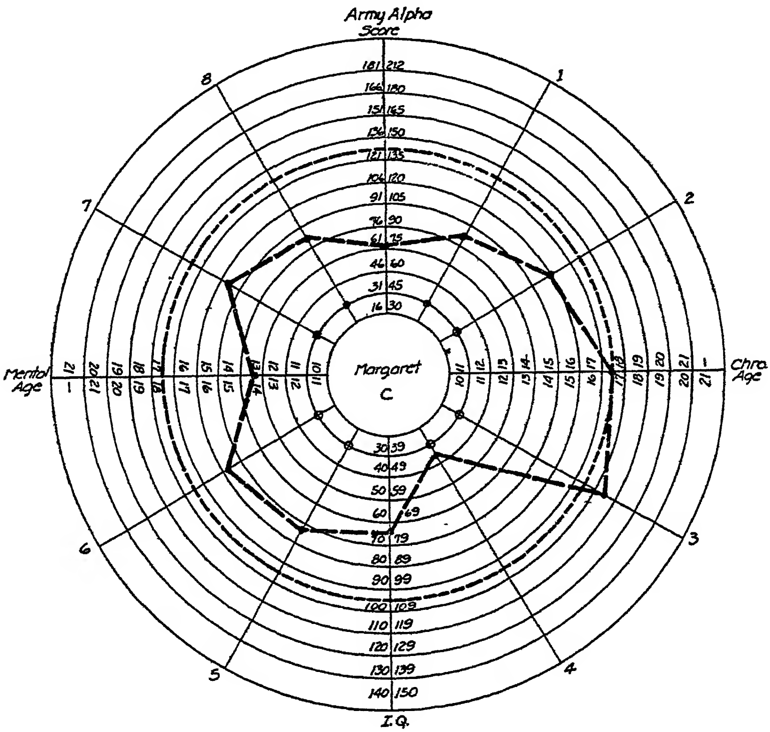
Test 1.	Following instructions	76
Test 2	Arithmetic problems	80
Test 3	Practical judgment	85
Test 4	Synonyms - anonyms	70
Test 5	Disarranged sentences	83
Test 6	Number series	80
Test 7	Analogies	86
Test 8	Information	82

Total ---------------------------------- 652
Divided by 8 is 81 1-2 per cent.
81 1-2 per cent of 212 is 173, score.
Score ---------------------------------- 173
Chronological age --------------------- 14-5
I. Q. ---------------------------------- 144
Mental age -------------- 20 years, 10 months

The Psychographs Explained

A. The graph contains thirteen concentric circles. The outer circle indicates the following: (1) the limit of 212 points, the highest possible composite score to be made in the Army Alpha;

(2) the highest I. Q. which corresponds with the highest score; (3) the chronological age that corresponds with this high score and the high I. Q.;



Test 1	23
Test 2	41
Test 3	62
Test 4	0
Test 5	34
Test 6	38
Test 7	38
Test 8	25
Total	261

Divided by 8 is 32 1-2 per cent.

Ttake 32 1-2 per cent of 212 is 70, score.

Score	70
Chronological age	17
I. Q.	70
Mental age	13 years

(4) the mental age that corresponds with the high score, the I. Q., and the chronological age. (The other smaller circles keep up this relation among the factors, viz. - score, I. Q., the chronological age, the mental age);

(5) and the highest per cent possible in each of the eight separate tests that make up the Army Alpha. For example, test I, highest is 12 points; test 2, highest is 20 points; test 3, highest is 16 points; test 4, highest is 40 points; test 5, highest is 24 points; test 6, highest is 20 points; test 7, highest is 40 points; test 8, highest is 40 points. Making a total of 212 points or composite score. If in any of these tests the points are all correct, then the per cent for that test is 100, and it is so indicated by a dot in the outer circle. If, for instance, one-half of the test is correct then the per cent is 50 and is so indicated by a dot on the 50 circle. If three-fourths of the test is correct then the per cent is 75, and a dot is placed halfway between the circle 70 and the circle 80. In like manner test 2 is indicated, test 3, etc. Then these dots are joined by a continuous red line in the original graph, but shown in figures 1 and 2 by long heavy dashes, which make the person's psychograph.

The total score is found by adding up the points in each test and indicating this score in the score column, which is the column that goes up from the center circle, by steps as 16-30, 31-45, 46-60, 61-75, 76-90, 91-105, 106-120, 121-135, 136-150, 151-165, 166-180, 181-212. (See figures 1 and 2).

Having indicated the total score for a student in his graph, we next indicate by a dot, the I. Q. to which this score entitles him in the I. Q. column which is down from the center circle, opposite the score column, and is grouped to correspond to the score rankings as 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, 100-109, 110-119, 120-129, 130-139, 140-149.

The chronological ages are indicated on the right of the psychograph as follows: 10-11, 11-12, 12-13, 13-14, 14-15, 15-16, 16-17, 17-18, 19-20, 20-21, 21—.

The mental ages are indicated on the left of the psychograph as follows: 10-11, 11-12, 12-13, 13-14, 14-15, 15-16, 16-17, 17-18, 18-19, 19-20, 20-21, 21—.

As we noted above, each circle keeps up the relation between the factors: score (at the top), chronological age (at the right), I. Q. (at the bottom), and the mental age (at the left).

The red line (long, heavy dashes in figures 1 and 2), now connects and shows the following:

a. The per cent made in each of the eight tests.
b. The total composite score.
c. The mental age.
d. The chronological age.
e. The I. Q.

In other words the red line (long, heavy dashes) gives twelve items from the Army Alpha Test.

Besides adding up the points made in each of the eight tests to get the composite score, it may be found by adding up the per cents of the eight tests, dividing this sum by 8, and taking this per cent of 212, the total or highest score possible. To illustrate from Psychograph 1: The per cents of the tests in the order are 76, 80, 85, 70, 83, 80, 86, and 82; the sum of these per cents is 652 which divided by 8 gives 81 1-2 per cent average. Take 81 1-2 per cent of 212 and the result is 173, which is the total score made by the person who is here designated as "Terry". The same can be done with the psychograph 2, marked as "Margaret". The same procedure was used with the 70 psychographs, not here included.

If the reader will consult his Army Alpha Test he will see just what each of the eight tests is intended to measure. Then a psychograph will show at a glance just where the student is weak or strong in each of these eight fields. Again consider "Terry". His range was from 70 to 86, with average of 82. His teachers pronounced him a strong student in all of his school subjects, thus verifying the findings of this intelligence test. In the case of the psychograph marked "Margaret" the judgments of the teachers were again so verified. In fact all of the 70 psychographs were subjected to these same criteria.

C. Another feature of these psychographs should be explained. Starting with the chronological age of the student as indicated on the graph, draw a green line (short dashes used in figures 1 and 2) around the circle from his chronological age, this will show just what score he ought to make, what his I. Q. should be, and what his mental age should be if he is normal. That is, his chronological age sets these others.

D. Then, finally study the red line (long, heavy dashes in figures 1 and 2) of the psychograph in comparison with the green line (short dashes) and you have a pictorial, or better still, a graphic representation of the student's actual normality, super-normality, or subnormality, and just in which of the eight tests these discrepancies are found.

E. In the center are placed the student's name and his letter rank, as given in the Army Alpha manual.

F. The two psychographs were chosen because each is outstanding in type. The one for "Terry" shows the mental age outside the green line (short dashes) which is the normal line for "Terry. The one for "Margaret" shows the green line (short dashes), the normal line for her, outside the red line (long heavy dashes), her mentality.

AN INTERLOCKING TABLE FOR USE IN THE CALCULATION OF MULTIPLE CORRELATION COEFFICIENTS

E. R. WOOD

The equation used to obtain the multiple correlation coefficient of three variables may be written

$$R1.23=\sqrt{1-(1-r^{2}12)\ (1-r^{2}13.2)}$$

$$R1.23=\sqrt{1-(1-.5^{2})\ (1-.6^{2})}$$

The equation used to obtain the multiple correlation coefficient of six variables may be written

$$R1.23456=\sqrt{1-(1-r^{2}12)\ (1-r^{2}13.2)\ (1-r^{2}14.23)\ (1-r^{2}15.234)\ (1-r^{2}16.2345)}$$

By inspection, one can immediately realize the need for time saving devices that will insure a high degree of accuracy.

The purpose of this paper is to proceed immediately to the consideration of an Interlocking Table for Use in Obtaining the Multiple Correlation value of any combination of variables, having given the value of all needed partials.

The following sets of equations are given to assist the reader in becoming acquainted with the equations and their relationships.

Equations (1), (4), and (7) are of regular notation. For ease of expression letters have been substituted for the r's in equation (2), (5), and (8). In equations (3), (6), and (9) numerical values have been substituted for illustrative purposes.

(1) $R1.23=\sqrt{1-(1-r^{2}12)\ (1-r^{2}13.2)}$

(2) $R=\sqrt{1-(1-a^{2})\ (1-b^{2})}$

(3) $R=\sqrt{1-(1-.5^{2})\ (1-.6^{2})}$

(4) $R1.234=\sqrt{1-(1-r^{2}12)\ (1-r^{2}13.2)\ (1-r^{2}14.23)}$

(5) $R1=\sqrt{1-(1-a^{2})\ (1-b^{2})\ (1-c^{2})}$

(6) $R_{1}=\sqrt{1-(1-.5^{2})\ (1-.6^{2})\ (1-.7^{2})}$

(7) $R1.2345=\sqrt{1-(1-r^{2}12)\ (1-r^{2}13.2)\ (1-r^{2}14.23)\ (1-r^{2}15.234)}$

(8) $R2=\sqrt{1-(1-a^{2})\ (1-b^{2})\ (1-c^{2})\ (1-d^{2})}$

(9) $R2=\sqrt{1-(1-.5^{2})\ (1-.6^{2})\ (1-.7^{2})\ (1-.8^{2})}$

Consider equation

(2) $R=\sqrt{1-(1-a^{2})\ (1-b^{2})}$

(10) Let $M=(1-a^{2})\ (1-b^{2})$

(11) Then $R=\sqrt{1-M}$

(12) And $M=(1-R^{2})$

Equations (11) and (12) make possible the interlocking tables.

The final value of R (2) can be utilized in equation (5) for obtaining the final value of R_{1}.

It is convenient to bring together equations that have a direct bearing on the next step.

(5) $R_{1}=\sqrt{1-(1-a^{2})\ (1-b^{2})\ (1-c^{2})}$

(10) $M=(1-a^{2})\ (1-b^{2})$

(12) $M=(1-R^{2})$

By substituting the value of M (12) in (5) equation (13) is obtained.

(13) $R_1=\sqrt{1-(1-R^2)\ (1-c^2)}$

(14) Let $N=(1-R^2)\ (1-c^2)$

(15) Then $R_1=\sqrt{1-N}$

(16) And $N=(1-R^2)$

Equations (15) and (16) are identical in form to equations (11) and (12). In like manner it may be shown that the final value of R_1 may be utilized in equation (9) to obtain the final value of R_2.

$R_2=\sqrt{1-(1-R_1^2)\ (1-d^2)}$

The Nature of The Tables

Since all correlation values utilized in the multiple correlation equation are squared, only positive values between 0 and 1.00 need be considered. The table is similar to any product table. This table contains the product of all numbers between 0 and 1. Those who are familiar with either the large product table or the table of logarithms will understand the nature of this table.

Just as the large product table can be utilized, so can this table be used.

2x3x4=24.

	0	1	2	3*	4	5	6*
0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6
2*	0	2	4	6*	8	10	12
3	0	3	6	9	12	15	18
4*	0	4	8	12	16	20	24*

A Section of the Multiple Correlation Table

	.00	.01	.02	.03	.04	.05
00	.00	.01	.02	.03	.04	.05
.01	.01	.0141	.0224	.0316	.0412	.0510
.02	.02	.0224	.0283	.0360	.0447	
.03	.03	.0316	.0360	.0424		
.04	.04	.0412	.0447			

How Tables May Be Used

(3) $R = \sqrt{1-(1-.5^2)\ (1-.6^2)} = .7211$

	.60	.61	.62
.50	.7211		
.51			

Final value of $R = .7211$

(6) $R_1 = \sqrt{1-(1-.5^2)\ (1-.6^2)\ (1-.7^2)}$ has been reduced to
$R_1 = \sqrt{1-(1-R^2)\ (1-.7^2)}$ or $\sqrt{1-(1-.72)\ (1-.7^2)}$

	.70	
.72	.8686	

Final value of $R_1 = .8686$

(9) $R_2 = \sqrt{1-(1-.5^2)\ (1-.6^2)\ (1-.7^2)\ (1-.8^2)}$ has been reduced to
$\sqrt{1-(1-R_1^2)\ (1-.8^2)}$ or $\sqrt{1-(1-.87^2)\ (1-.8^2)} = .9552$

.85		
.86		
.87	.9552	

Final value of $R_2 = .9552$

$R_8 \sqrt{1-(1-.5^2)\ (1-.6^2)\ (1-.7^2)\ (1-.8^2)\ (1-.2^2)} = .9616$ final value of R.

	.95	.96
.20		.9616

Final value of $R_8 = .9616$

Summary of consecutive values found in tables used to obtain value of R_3.

$$R_3=\sqrt{1-(1-.5^2)\ (1-.6^2)\ (1-.7^2)\ (1-.8^2)\ (1-.2^2)}$$

.7211 .8686 .9552 .9616—Final value of R_3

Machine Calculation

$$\sqrt{1-(.75)\ (.64)\ (.51)\ (.36)\ (.96)} =$$

$$\sqrt{1-(.0846028800)}=$$

$$\sqrt{.91539712} = .9567.$$

The difference between the table calculation and machine calculation is .0049.

THE WHEAT FOOT-ROT DISEASE IN KANSAS[1]

Paper 13 of the 1922 meeting at Manhattan

L. E. MELCHERS
Kansas State Agricultural College
Manhattan, Kansas

This disease was first brought to the attention of the writer in the spring of 1920, specimens having been sent from Dickinson County. It is problematical how long the disease has actually been in this county, however, there is evidence which leads one to believe that it has been present in Kansas for at least three or four years. Since 1920, however, it has become much more conspicuous. A careful survey in the spring of 1921 has shown the disease to be present in a number of fields in this county. The wheat foot-rot has also been located to a slight extent in Saline, Riley and Cheyenne counties. In all, seventeen fields on eleven different farms in the above named counties have shown distinct cases of wheat foot-rot. It is quite probable that it will be found in a number of other parts of the state in 1922.

The disease caused almost a total crop loss in one or two fields in Dickinson County in 1921. Both hard and soft wheats seem equally affected. The disease occurs in scattered, more or less circular or irregular spots, varying from a few feet to twenty or thirty feet in diameter. These spots are independent of topographical or soil conditions. It has been found, upon questioning some of the farmers, that this disease occurred in only a few spots in some of the fields two years ago. The farmers thought it was due to "thin soil conditions". In some cases fertilizers were applied to these spots, but instead of checking the disease, it became more noticeable the following season.

The first symptom of the wheat-foot rot consists of a yellowish and stunting of affected plants shortly after they begin to make the spring growth. This yellowing condition continues, becoming more pronounced as the crop approaches maturity. Diseased plants become bleached, dry, remain stiff and upright without producing normal heads. The plants which do reach the heading stage are very short

1. Contribution No. 211 from the Department of Botany & and Plant Pathology Kansas Agricultural Experiment Station.

and do not generally produce grain. The root system of a diseased plant, if carefully examined, will be found to be poorly developed, since most of the roots have decayed. Diseased plants pull out of the ground very easily. A noticeable blackened condition of the lowermost node just above the root is visible., hence the common name which has been assigned to the malady. The blackened areas show signs of distinct fungus invasion. Since this tissue is so badly infected, it causes malnutrition. A black scale, or plate of interwoven mycelium can sometimes be found upon very close examination.

This disease resembles quite closely the field behavior of a disease which has occurred in Australia for a number of years and is known as the "take-all" diesase, but it differs in several respects from the so-called take-all disease which has recently been found in the states of Indiana and Illinois. The cause of the disease in Kansas is not as yet definitely known. Studies thus far made, show the species of the fungus Helminthosporium and Hendersonia associated with the infected tissues. These have been isolated frequently. Further cultural studies are in progress and inoculation experiments will be conducted to determine what relationships exist between these organisms and the foot-rot of wheat as it occurs in Kansas.

Experimental Investigations

At the present time, very extensive cooperative experiments are being conducted in Dickinson County. Approximately five acres of land are being devoted to experiments to discover whether any varietal resistance occurs and to note what effect soil amendments, fertilizers, soil disinfection and crop rotation have in controlling this disease. Half of this field is in these experiments this year, the remainder being entirely sown to wheat. By keeping half of the land in a susceptible variety of wheat, the soil will become more thoroughly infested with the organisms, thereby offering the best opportunity for studying this disease the following season, since the organism is thought to live over chiefly in the soil.

One hundred and fifty rod-rows of various varieties of hard and soft winter wheats have been planted in this field in the infected soil to discover whether varietal resistance occurs. A number of head selections were made in 1921 from plants which were growing in diseased spots. It is thought that perhaps some of these may show natural resistance. These have been planted in the diseased soil.

Plots have been laid out which will receive definite quantities of certain soil amendments and fertilizers. Records of their effect on this disease will be kept. A second set of plots has been provided for definite crop rotations, which will help to determine what crops can safely follow wheat. Also ,the effect of fallowing the land will be

carefully observed. A number of small plots have been treated with formaldehyde to discover whether disinfecting the soil will control the disease.

There is some evidence that the causal organism may live on wild grasses, therefore, a study of the grasses in the prairie land adjoining these fields is being made. The various species will be grown in infected soil. Wheat seed which came from fields known to be free from the disease was planted in a prepared seed bed of prairie land. This may show whether the organism occurs on grasses.

The Departments of Botany and Plant Pathology and Agronomy of the Kansas Agricultural Experiment Station and the Office of Cereal Investigations, United States Department of Agriculture, Washington, D. C., are cooperating in these investigations. The work will probably be continued for a series of four or five years, or as long as seems necessary.

TAKE-ALL DISEASE OF WHEAT IN KANSAS[1]

Paper 29 of the 1923 meeting at Lawrence

R. P. WHITE AND L. E. MELCHERS

Kansas State Agricultural College
Manhattan, Kansas

A wheat disease resembling take-all in its appearance was first observed in Kansas in 1920. As the organisms associated with its occurence in the fields were not determined, it was tentatively called "foot-rot". Concerning it, McKinney and Melchers[2] state, "the disease resembles the true take-all disease occurring in this country and described in foreign literature, but differs in several respects from the so-called take-all occurring in Illinois and Indiana. The cause of the disease in Kansas remains unknown."

Extensive isolation and cultural studies were made during the past crop season with the result that Ophiobolus sp., has been isolated from a number of fields where "foot-rot" has occurred. Mature perithecia of this fungus have also been found on the stubble in various fields and single spore cultures therefrom have been made. These cultures are identical with the numerous cultures which were made from the blackened lesions of the lowermost nodes of the wheat plants early in the spring, but prior to the occurrence of the perithecia on the mature plants.

Mr. H. H. McKinney of the Office of Cereal Investigations, United States Department of Agriculture, Washington, D. C., also reported the finding of mature perithecia on Kansas material, having examined several fields in the company of the writers and collected stubble for cultural studies.

While mature perithecia of Ophiobolus sp. have not yet been produced in artificial cultures in Kansas, there is every reason to believe that the cultures are of this organism, since they agree with known cultures when grown under identical conditions on a variety of artificial media. The disease in the field has been reported in Cheyenne, Dickinson, Riley, Jefferson, Saline, Leavenworth, McPherson and Rice counties and in all probability occurs in other counties. Ophiobolus sp. has been isolated from diseased plants from Riley, Dickinson, and Rice counties. Mature perithecia have also been found on wheat stubble from Dickinson and Rice counties.

Other organisms associated with diseased wheat plants have been Helminthosporium sp. and Wojnowicia graminis (McAlp.) Sacc. & D. Sacc. Their association with diseased plants is being studied.

1. Contribution No. 197 from the Department of Botany and Plant Pathology, Kansas Agricultural Experiment Station, in cooperation with the Office of Cereal Investigations, United States Department of Agriculture.

2. McKinney, H. H., and Melchers, L. E., 1922 Foot-rot diseases of wheat in Kansas (abstract), Phytopathology, 12:27-28.

STUDIES OF FOOT-ROT OF WHEAT (TAKE-ALL) IN KANSAS
SECOND REPORT OF PROGRESS[1]

Paper 30 of the 1923 meeting at Lawrence

L. E. MELCHERS AND H. H. McKINNEY
Kansas State Agricultural College
Manhattan, Kansas

It seems desirable to present at this time a report of some of the investigations relating to foot-rot or take-all of wheat in Kansas. Two papers by Melchers[2] and by White and Melchers[3] relate to the identification of at least one of the organisms associated with foot-rot as it occurs in Kansas.

Some new developments have occurred during the past year which it seems desirable to mention. In 1921 foot-rot was reported from Saline, Riley, Dickinson, and Cheyenne Counties. In 1922 it was also reported from McPherson, Leavenworth, Jefferson and Rice Counties. Suspicious material was also collected in Sedgwick and Morris Counties, but definite evidence as to the presence of the causal orgasism is lacking.

These observations indicate that foot-rot has not increased in Kansas at an alarming rate during the past season. In certain plots on the agronomy farm of the Kansas Agricultural Experiment Station in Riley County, there has been a definite increase in infestations. Many new spots occurred. The plots in question are continuously cropped to wheat. The spots which were first observed in 1921 have increased in size from 100 to 400 per cent as shown by records for 1921 and 1922.

In some experimental plots in Dickinson County, the disease was somewhat more prevalent. It developed earlier on certain plots that were treated with lime and gypsum. This may indicate that an alkaline condition of the soil favors the development of the organism.

The symptoms in 1922 were somewhat different from those of 1921; in 1921 most of the infected plants died about the time the plants began to "shoot". In 1922 diseased wheat was able to continue to the heading stage. This may have been due to the wet spring of the

1. Contribution No. 198 from the Department of Botany & Plant Pathology, Kansas Agricultural Experiment Station in cooperation with the Office of Cereal Investigations, United States Department of Agriculture, Washington, D. C.

2. Melchers, L. E. 1922. The wheat foot-rot in Kansas, Kan. Acad. Sci. Published Trans. Kan. Acad. Sci., 32:137, 1929.

3. White, R. P. and Melchers, L. E. 1923 Take-all disease of wheat in Kansas, Kan. Acad. Sci. Published Trans. Kan. Acad. Sci. 32:139, 1929.

past season. Also, many more white-heads were observed in 1922 than in 1921.

The first signs of the disease in Dickinson County in 1922 were observed May 12 and 13, on the Engle farm. No definite symptoms could be found on the Kauffman farm where the experimental plots are located, but a few suspicious spots were observed. Most careful examinations made during the fall of 1922 failed to disclose any symptoms and perhaps indicate that this disease cannot be detected at that time of the year. Wheat plants growing in spots known to have been infested the previous year appeared normal in every respect. This condition apparently prevailed until late in the spring. It is possible that certain climatic factors suppress the early symptoms of this disease and hence additional observations relating to this phase apparently will be necessary.

Since a few of the wild grasses are known to be hosts for this disease, a careful study was made of the 32 grasses growing in the prairies adjoining infested fields. Seedlings of the different species were grown and transplanted in soil which came from infested spots. The soil was placed in trenches in the field in which the grasses were grown to maturity. An examination at the end of the season did not show the presence of Ophiobolus.

It is impossible to state how serious this disease is likely to become in Kansas. It may disappear for a period and reappear later. There is no question but that it produces a great deal of damage in fields where it is common. The present recommendations are to discontinue growing wheat in fields that are diseased for a period of several years. Since the other cereals are known to be attacked by Ophiobolus, it is not advisable to grow any of them in infested fields, with perhaps the exception of oats. Where possible it is better to plant corn, sorghum, alfalfa, or some other legume.

TRANSACTIONS

OF THE

KANSAS ACADEMY OF SCIENCE

25-7-38

Volume XXXIII

Sixty-second Annual Meeting

April 17-19, 1930

Kansas State Teachers College
Hays, Kansas

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Manhattan, Kansas.

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CONSTITUTION*

SECTION 1. This association shall be called the Kansas Academy of Science.

SEC. 2. The objects of this Academy shall be to increase and diffuse knowledge in various departments of science.

SEC. 3. The membership of this Academy shall consist of three classes: annual, life and honorary.

(1) Annual members may be elected at any time by the committee on membership, which shall consist of the secretary and other members appointed annually by the president. Annual members shall pay annual dues of one dollar, but the secretary and treasurer shall be exempt from the payment of dues during the years of their service.

(2) Any person who shall have paid thirty dollars in annual dues, or equivalent due to legal exemption, or in one sum, or in any combination, may be elected to life membership, free of assessment, by a two-thirds vote of the members present at an annual meeting.

(3) Honorary members may be elected because of special prominence in science upon written recommendation of two members of the Academy, by a two-thirds vote of the members present. Honorary members pay no dues.

SEC. 4. The officers of this Academy shall be chosen by ballot at the annual meeting, and shall consist of a president, two vice presidents, a secretary and a treasurer, who shall perform the duties usually pertaining to their respective offices. The president, the secretary and the treasurer shall constitute the executive committee. The secretary shall be in charge of all the books, collections and material property belonging to the Academy.

SEC. 5. Unless otherwise directed by the Academy, the annual meeting shall be held at such time and place as the executive committee shall designate. Other meetings may be called at the discretion of the executive committee.

SEC. 6. This constitution may be altered or amended at any annual meeting by a vote of three-fourths of attending members of at least one year's standing.. No question of amendment shall be decided on the day of its presentation.

SEC. 7. This Academy shall have an executive council consisting of the president, the secretary, the treasurer, the vice presidents, and four other members to be nominated by the nominating committee and elected as the other officers. This council shall have general oversight of the Academy not otherwise given by this constitution to officers or committees.

*As modified by amendments.

BY-LAWS

I. The first hour, or such part thereof as shall be necessary, in each session shall be set aside for the transaction of the business of the Academy. The following order of business shall be observed, so far as practicable.

1. Opening
2. Reports of officers.
3. Reports of standing committees.
4. Appointment of special committees.
5. Unfinished business.
6. New business.
7. Reports of special committees.
8. Election of officers.
9. Election of members.
10. Program.
11. Adjournment.

II. The president shall deliver a public address on the evening of one of the days of the meeting, at the expiration of his term of office.

III. No meeting shall be held without a notice of the same having been published in the papers of the state at least thirty days previous.

IV. No bill against the Academy shall be paid by the treasurer without an order signed by the president and secretary.

V. Members who shall allow their dues to remain unpaid for two years, having been annually notified of their arrearages by the treasurer, shall have their names stricken from the roll.

VI. The secretary shall have charge of the distribution, sale and exchange of the published Transactions of the Academy, under such restrictions as may be imposed by the executive committee.

VII. Eight members shall constitute a quorum for the transaction of business.

VIII. The time allotted to the presentation of a single paper shall not exceed fifteen minutes.

IX. No paper shall be entitled to a place on the program unless the manuscript, or an abstract of the same, shall have been previously delivered to the secretary.

PAST PRESIDENTS

1869—1870	B. F. Mudge
1871—1873	John Fraser
1874—1878	F. H. Snow
1879—1880	B. F. Mudge
1881—1882	J. T. Lovewell
1883	A. H. Thompson
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1886	E. L. Nichols
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1920-21	O. P. Dellinger
1921-22	Roy Rankin
1922-23	R. K. Nabours
1923-24	H. P. Cady
1924-25	H. H. Nininger
1925-26	J. E. Ackert
1926-27	H. J. Harnly
1927-28	Mary T. Harman
1928-29	L. D. Wooster
1929-30	W. B. Wilson

MEMBERSHIP OF THE ACADEMY

SEPTEMBER 1, 1936

Abbreviations: The following abbreviations for institutions have been used.

K. S. A. C. Kansas State Agricultural College.
K. S. T. C. Kansas State Teachers College.
U. of K. University of Kansas.

Other abbreviations follow those used in the Summarized Proceedings of the American Association for the Advancement of Science.

The year given indicates the time of election to membership.

HONORARY MEMBERS

Barber, Marshall A., Ph. D., 1904, Internat. Health Div., Rockefeller Found., 61 Broadway, New York, N. Y.

Cockerell, T. D. A., D. Sc., 1908, prof. zoology, Univ. Colorado, Boulder, Col.

Franklin, W. S., Sc. D., 1897, prof. physics, Mass. Inst. Tech., Cambridge, Mass.

Franklin, Edward Curtis, Ph. D., 1884, prof. chemistry, Leland Stanford Jr. Univ., Cal.

Grimsley, G. P., Ph. D., 1896, geological eng., B. & O. R. R., 4405 Underwood Road (Guilford), Baltimore, Md.

Hitchcock, A. S., Sc. D., 1892, principal botanist, U. S. Dept. Agric., Washington, D. C.

Harris, J. Arthur, Ph. D., 1900, head Dept. Botany, Univ. Minnesota, Minneapolis, Minn.

Kellogg, Vernon L., LL. D., Sc. D., 1920, permanent sec. National Research Council, Washington, D. C.

McClung, C. E., Ph. D., 1903, dir. Zoology Lab., Univ. Pennsylvania, Philadelphia, Pa.

McCollum, E. V., Ph. D., Sc. D., 1902, prof. biochemistry, John Hopkins Univ., Baltimore, Md.

Nichols, Edward L., Ph. D., Sc. D., 1885, (honorary member 1897), prof physics (emeritus) Cornell Univ., Ithica, N. Y.

Riggs, Elmer S., M. A., 1896, assoc. curator paleontology, Field Mus. Nat. Hist. Chicago, Ill.

Wagner, George, M. A., 1894, (honorary member 1904) assoc. prof. zoology, Univ. Wisconsin, Madison, Wis.

LIFE MEMBERS

Agrelius, Frank U. G., M. A., 1905, assoc. prof. biol., K.S.T.C., Emporia, Kan.

Allen, Herman Camp, Ph. D., 1904, prof. chemistry, U. of K., Lawrence, Kan.

Bailey, E. H. S., Ph. D., 1883, prof. chemistry, U. of K., Lawrence, Kan.

Bartholomew, Elam, Sc. D., 1896, 415 W. Sixth St., Hays, Kan.

Bartow, Edward, Ph. D., Sc. D., 1897, prof. and head of Dept. of Chemistry and Chem. Engr., Univ. Iowa, Iowa City, Iowa.

Baumgartner, William J., Ph. D., 1904, assoc. prof. zoology, U. of K., Lawrence, Kan.

Beede, Joshua W., Ph. D., 1894, prof. geology and paleontology, Indiana Univ., Bloomington, Ind.

Berry, Sister M. Sebastian, A. B., 1911, Supt. Schools, St. Paul, Kan.
Bushnell, Leland D., Ph. D., 1908, prof. and head Bacteriology Dept., K. S. A. C., Manhattan, Kan.
Bushong, F. W., Sc. D., 1896, 2636 Fifth St., Port Arthur, Tex.
Cady, Hamilton P., Ph. D., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Copley, Rev. John T., 1903, Olathe, Kan.
Cragin, F. W., Ph. D., 1880, 912 Migeul St., Colorado Springs, Col.
Crevecoeur, F. F., 1900, Onaga, Kan.
Cook, W. A., M. S., 1907, real estate business, 1414 Highland St., Salina, Kan.
Dains, Frank Burnett, Ph. D., 1902, prof. chemistry, U. of K., Lawrence, Kan.
Deere, Emil O., M. S., 1905,, dean and prof. biology, Bethany Col., Lindsborg, Kan.
Dellinger, Orris P., Ph. D., 1909, prof. biology, K. S. T. C., Pittsburg, Kan.
Dunlevy, R. B., M. A., 1896, Southwestern Col., Winfield, Kan.
Eby, J. Whit, B. S., 1903, banker, Howard, Kan.
Failyer, George H., M. S., 1879, retired, R. R. 4, Manhattan, Kan.
Faragher, Warren Fred, Ph. D., research chemist, Universal Oil Produce Co., Riverside, Ill.
Garrett, A. O., M. A., 1901, head Dept. Biology, East High School, Salt Lake City, Utah.
Graham, I. D., M. S., 1879, State Board of Agric., Topeka, Kan.
Harman, Mary T., Ph. D., 1912, prof. zoology, K. S. A. C., Manhattan, Kan.
Harnly, Henry J., Ph. D., 1893, prof. biology, McPherson Col, McPherson, Kan.
Harshbarger, William A., Sc. D., 1903, prof. mathematics, Washburn Col., Tokeka, Kan.
Havenhill, L. D., Ph. C., 1904, dean School Pharmacy, U. of K., Lawrence, Kan.
Haworth, Erasmus, Ph. D., 1882, U. of K., Lawrence, Kan.
Knaus, Warren M., D. Sc., 1882, entomologist, editor "Democrat Opinion", McPherson, Kan.
McWharf, J. M., M. D., 1902, 715 Princeton St., Ottawa, Kan.
Meeker, Grace R., A. B., 1899, 709 S. Mulberry, Ottawa, Kan.
Menninger, C. F., M. D., 1903, 1407 W. Tenth St., or R. 4, Topeka, Kan.
Miller, Ephraim, Ph. D., 1873, 558 North Lakes Ave., Pasadena, Cal. (Prof. emeritus mathematics and astronomy, U. of K.)
Nabours, Robert K., Ph. D., 1910, prof. and head Zoology Dept., K. S. A. C. Manhattan, Kan.
Nissen, A. M., A. B., 1888, farmer, Wetmore, Kan.
Peace, Larry M., 1904, West Ninth St., Lawrence, Kan.
Robertson, W. R. B., Ph. D., 1905, K. S. A. C., Manhattan, Kan.
Reagan, Albert B., Ph. D., 1904, Indian Field Service, Ouray, Utah.
Schaffner, John H., M. S., 1903, research and prof. botany, Ohio State Univ., Columbus, Ohio.
Scheffer, Theodore, M. A., 1903, assoc. biologist, U. S. Biological Survey, Puyallup, Wash.
Shirk, J. A. G., 1904, prof. mathematics, K. S. T. C., Pittsburg, Kan.
Shelley, Edwin Taylor, M. D, 1892, Atchison, Kan. (Deceased 1927).
Smith, Alva J., 1892, consulting eng., 810 Boylston St., San Diego, Cal.
Smyth, Lumina C. R., Ph. D., 1902, 235 Acton Road, Columbus, Ohio.
Sterling. Charles M., A. B., 1904, assoc. prof. botany and pharmacognosy, U. of K. Lawrence, Kan.
Sternberg, Charles H., M. A., 1896, 4046, Arizona St,. San Diego, Cal.
Welin, John Eric, D. Sc., 1889, prof. chemistry, Bethany Col., Lindsborg, Kan.
Willard, Julius T., D. Sc., 1883, vice-pres. K. S. A. C., Manhattan, Kan.
Wilson, William B., Sc. D., 1903, head Biology Dept., Ottawa Univ., Ottawa, Kan.
White, E. A., M. A., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Wooster, Lyman C., Ph. D., 1889, prof. biology and geology, K.S.T.C., Emporia, Kan.
Yates, J. A., Ph. D., 1898, prof. chemical and physical science, K.S.T.C., Pittsburg, Kan.

ANNUAL MEMBERS

Members paid up for 1930 are indicated by an asterisk*. The year given is that of election to membership. If two years are given, the second signifies reelection.

*Ackert, James Edward, Ph. D., 1919, prof. zoology and parasitologist, K. S. A. C., Manhattan, Kan.
*Albertson, F. W., B. S., 1928, assoc. prof. agric., Hays, Kan.
*Albright, Penrose S., M. S., 1926, asst. prof. physics and chemistry, Southwestern Col., Winfield, Kan.
Alexander, Jean, M. S , 1929, Vivarium, U. of Illinois, Urbana, Ill.
*Allen, Fred W. Jr., M. A., 1927, 317 Stanford, Albuquerque, N. M.
*Aicher, L. C., B. S., 1930, supt. Ft. Hays Branch, Kansas State Agricultural College Expt. Sta., Hays, Kan.
Almquist, E. C., A. B., 1929, instr. physics, Hutchinson City Schools, Hutchinson, Kan.
*Ayers, H. D., 1928, Univ. Wichita, Wichita, Kan.
*Baden, M. W., A. B., box 520, Winfield, Kan.
Barker, J. F., A. B., 1930, student, U. of K., Lawrence, Kan.
*Barton, Arthur W., Ph. D., 1928, prof. botany, K. S. T. C., Hays, Kan.
*Barnett, R. J., M. S., 1922, prof. horticulture, K. S. A. C., Manhattan, Kan.
*Bartley, S. H., A. M., 1930, inst. psychology, U. of K., Lawrence, Kan.
*Bennett, Dewey, M. A., 1928, head science dept., Junior College, Garden City, Kan.
Bennett, James L., M. A., 1928, prof. physics, Ottawa Univ., Ottawa, Kan.
Bengsten, Linus, 1924, chemistry, Bethany Col., Lindsborg, Kan.
*Bird, J. S., B. S., 1929, pres. Wheat Farming Co., Hays, Kan.
*Boone, George N., M. S., 1930, Indust Educ. Dept., McPherson Col., McPherson, Kan.
Borman, Ina M., B. S., 1928, supervisor science, K. S. T. C., Emporia, Kan.
*Broughton, L. L., B. S., 1929, instr. pharmacy, U. of K., Lawrence, Kan.
*Bowman, J. L., M. S., 1928, McPherson Col., MsPherson, Kan.
*Bradbury, Dorothy, Ph. D., 1929, 1420 Polk St., Topeka, Kan.
*Branch, Hazel E., Ph. D., 1924, prof. zoology, Wichita Univ., Wichita, Kan.
*Brown, Maud A., 1929, bur. sch. health service, U. of K., Lawrence, Kan.
*Breukelman, John, Ph. D., 1930, prof. biology, K. S. T. C., Emporia, Kan.
*Brewster, Ray Q., Ph. D., 1919, prof. chemistry, U. of K., Lawrence, Kan.
Brinkley, J. R., M. D., 1923, physician, Milford; Kan.
Britton, Wiley, 1923, 4 Mill St., Kansas City, Mo.
*Brooks, Charles H., B. S., 1928, instr. corres. study, Hays. Kan.
*Brubaker, H. W., Ph. D., 1929, prof. chemistry, K. S. A. C , Manhattan, Kan.
*Brungardt. Bernard J., B. S., 1930, prin. and sci. teacher, Schoenchen, Kan., P. O., Hays, Kan.
*Burt, Roy A., B. S., 1923, geologist, 738 Board of Trade, Kansas City, Mo.
*Call, L. E., M. S., 1922, dean Div. Agric., director Agric. Exper. Sta., K. S. A. C., Manhattan, Kan.
*Campbell, Marion I., M. S., 1929, grad. asst. zoology, K. S. A. C., Manhattan, Kan.
Chaney, Margaret, Ph. D., 1928, prof. food economics and nutrition, K. S. A. C., Manhattan, Kan.
*Carpenter, A. C., president Lesh Oil Co., Ottawa, Kan.
Cave, H. W., M. S., 1929, prof. dairy husbandry, K. S. A. C., Manhattan, Kan.
*Challans, Joanna Seiler, M. S., 1928, grad. research asst. zoology, K. S. A. C., Manhattan, Kan.
*Clarke, J. C., 1928, custodian Wupatki Nat'l. Mon., Flagstaff, Ariz.
Cook, G. S., A. B., 1922, Luray, Kan.
*Coonfield, Ben R., Ph. D., 1927, prof. biology Southwestern Col., Winfield, Kan.

*Conrad, L. E., M. S., 1930, prof. civil engr., K. S. A. C., Manhattan, Kan.
*Corey, William Lee, D. P. H., D. C., 1930, chiropractic physician, 721 Minnesota Ave., Kansas City, Kan.
*Cowan, Edwina, Ph. D., 1929, dir. Wichita Child Research Lab., Friends Univ., Wichita, Kan.
Cowles, Iva F., B. S., 1928, assoc. prof. clothing and textiles, K. S. A. C., Manhattan, Kan.
*Crow, H. Ernest, A. M., 1926, prof. biology, Friends Univ., Wichta, Kan.
*Cruise, Laurence Lolin, A. B., 1930, grad. student K. S. T. C., Hays, Kan.
*Dalbey, Nora E., 1929, prof. Dept. Botany, K. S. A. C., Manhattan, Kan.
*Davidson, Arthur W., Ph. D., 1927, assoc. prof. chemistry, U. of K., Lawrence, Kan.
*Davis, P. H., B. S., 1930, asst Soil Chemist, Branch Expt. Sta., Hays, Kan.
*Dean, George A., M. S., 1912, head Dept. Entomology, K. S. A. C., Manhattan, Kan.
DePuy, Percy L., M. S., 1929, instr. animal husbandry, K. S. A. C., Manhattan, Kan.
*DeSilva, H. R., Ph. D., 1930, psychology, U. of K., Lawrence, Kan.
*Dobrovolny, Chas., B. A., 1930, tech. and instr. zoology, K. S. A. C., Manhattan, Kan.
*Doell, J. H., A. B., 1926, prof. biology, Bethl Col., Newton, Kan.
*Douglass, J. R., M. S., 1928, asst. entomologist, U. S. Bureau Entomology, Estancia, N. M.
Dowd, Dorothea R., M. S., 1928, 301 Nat. Hist. Bldg., Urbana, Ill.
*Drake, J. P., M. A., 1930, prof. physics, K. S. T. C., Emporia, Kan.
*Dresher, C. H., 1930, history and science, McPherson Col., McPherson, Kan.
*Duley, F. L., Ph. D., 1929, prof. soils, Agronomy Dept., K. S. A. C., Manhattan, Kan.
Edgington, Orland, B. S., 1928, science teacher, Almena High School, Almena, Kan.
*Eldridge, Seba, Ph. D., 1928, prof. sociology, U. of K., Lawrence, Kan.
*Emery, W. T., M. A., 1928, science instr., High School North, Wichita, Kan.
*Evans, Neal E., B. S., 1926, instr. Junior High School, Manhattan, Kan.
*Farrell, F. D., B. S., 1924, president K. S. A. C., Manhattan, Kan.
*Fleming, Joe, 1930, student, K. S. T. C., Emporia, Kan.
*Flethcher, Worth A., Ph. D., 1928, assoc. prof. chemistry, Wichita Univ , Wichita, Kan.
Floyd, E. V., 1929, prof. physics, K. S. A. C., Manhattan, Kan.
*Foard, Castle W., M. S., 1930, prof. physics, Sterling Col., Sterling, Kan.
*Ford, Helen, Ph. D., 1928, head Dept. Child Welfare and Euthenics, K. S. A. C., Manhattan, Kan.
*Friesen, Abraham P., M. A., 1928, prof. physics, Bethel Col., Newton, Kan.
*Fryar, Raymond, 1930, K. S. T. C., Hays, Kan.
*Garrett, Frank A., B. S., 1929, instr. chemistry and physics, High School, Halstead, Kan.
*Gates, F. C., Ph. D., 1922, prof. botany, K. S. A. C., Manhattan, Kan.
*Garanson, Clifford E., B. S., 1927, Dwight, Kan.
*George, P. W., 1929, care of Buchans Mining Co., Buchans, Newfoundland.
*Gloyd, Howard K., M. S., 1922, instr. zoology, Univ. Michigan, Ann Arbor, Mich.
*Goldsmith, William M., Ph. D., 1924, prof. biology, Southwestern Col., Winfield, Kan.
*Greeder, Herman, D. V. M., 1928, box 387, Wichita, Kan.
Green, John D., 1929, head Science Dept., Central Col., McPherson, Kan.
*Greep, Roy A., 1930, B. S., grad. student zoology, Univ. Wisconsin, Madison, Wis.
*Gregory, P. W., Sc. D., 1929, prof. zoology, Baker Univ., Baldwin, Kan.
*Grimes, Waldo E., Ph. D., 1925, head Dept. Agric. Economics, K. S. A. C. Manhattan, Kan.
*Griswold, Sherwin B., B. S., 1930, prin. rural H. S., Hunter, Kan.

Gosselin, Charles J., A. B., 1928, Expt. Lab., New Orleans Ref. Co., Sellars, La.
*Gustafson, Vernon, 1930, McPherson, Col., McPherson, Kan.
Hafenrichter, A. L., Ph. D., 1928, prof. botany, Baker Univ., Baldwin, Kan.
*Hall, E. Raymond, Ph. D., 1923, 1929, curator mammals Museum Vertebrate Zoology, Univ. California, Berkeley, Cal.
*Hall, J. Lowe, Ph. D., 1929, asst. prof. chemistry, K. S. A. C., Manhattan, Kan.
*Hallstead, A. L., 1929, Hays, Kan.
*Hamilton, J. O., B. S., 1919, 1929, prof. physics, K. S. A. C., Manhattan, Kan.
*Harbaugh, M. J., A. B., 1930, instr. zoology, K. S. A. C., Manhattan, Kan.
*Harris, C. L., Ph. M., 1928, attorney-at-law, box 1088, Eldorado, Kan.
*Hartel, Lawrence W., M. S., 1930, asst. prof. physics, K. S. A. C., Manhattan, Kan.
*Harper, Bernice, M. S., 1930, grad. asst. zoology, K. S. A. C, Manhattan, Kan.
*Hartman, Hugh E., B. S., 1928, test. eng., 258 N. Martinson Ave., Wichita, Kan.
*Haymaker, H. H., Ph. D., 1930, prof. plant pathology, K. S. A. C., Manhattan Kan.
Henning, C. W., B. S., 1928, science teacher, High School, Stillwell, Kan.
*Henry, Edwin R., M. A., 1927, inst. psychology, Ohio State Univ., Columbus, Ohio.
*Herrick, Earl H., Ph. D., 1927, head Biology Dept., S. N. C., Natchitoches, La.
*Hershey, J. Willard, Ph. D., 1920, prof. chemistry, McPherson Col., McPherson, Kan.
*Hertzler, Arthur E., M. D., Ph. D., 1928, prof. surgery, Univ. Kansas Medical School, head surgeon Halstead Hosp., Halstead, Kan.
*Hess, Mrs. Katherine, M. S., 1926, asst. prof. clothing and textiles, K. S. A. C., Manhattan, Kansas.
*Hill, Robert T., 1928, M. S., grad. asst. zoology, Univ. Iowa, Iowa City, Iowa.
Hoard, Earl L., B. S., Kingsdown, Kan.
Hodges, Joseph M., B. S., 1928, technician, Dupray Lab., Hutchinson, Kan.
*Hoffman, William E., 1920, instr. Lingman Univ., Canton, China, (care China Union Univ., 150 Fifth Ave., New York City.
*Horn, Elsa, M. S., 1928, instr. botany, K. S. A. C., Manhattan, Kan.
*Horton, John R., B. S., 1922, entomologist, U. S. Dept. Agric., 128 South Minn. Ave., Wichita, Kan.
Howard, C. W., 1929, Supt. Schools, Holcomb, Kan.
Hughes, J. S., Ph. D., 1926, 1929, proof. chemistry, K. S. A. C., Manhattan, Kan.
*Humphrey, Irwin, M. S., research chemist, Hercules Pwd. Co., Kenvil, N. J.
*Hungerford, H. B., Ph. D., head Dept. Entomology, U. of K., Lawrence, Kan.
*Ibsen, Heman L., Ph. D., 1922, prof. genetics, Animal Husb. Dept., K. S. A. C. Manhattan, Kan.
*Jardine, W. M., Ph. D., 1919, Tower Bldg., Washington, D. C.
*Jehlik, Paul, 1930, student, K. S. T. C., Emporia, Kan.
*Jelinek, George, B. S., 1929, student, K. S. A. C., Manhattan, Kan.
*Jewell, Minna E., Ph. D., 1925, prof. zoology, Thornton Junior Col., Harvey, Ill.
*Johnson, George E., Ph. D., 1925, assoc. prof. zoology,, mammalogist Agric. Exper. Sta., Manhattan, Kansas.
Johnson, C. G. Harry, M. A., 1928, asst. prof. chemistry, Colorado Agric. Col., Fort Collins, Col.
*Johnson, E. W., B. S., 1930, nurseryman, Ft. Hays Expt. Sta., Hays, Kan.
*Johnson, Otis, B. S., 1930, teaching fellow, K. S. T. C., Hays, Kan.
*Johnston, C. O., M. S., 1928, asst. plant pathologist, K. S. A. C., Manhattan, Kan.
*Justin, Margaret M., Ph. D., 1925, 1928, dean Div. Home Economics, K. S. A. C., Manhattan, Kan.
*Kester, F. E., Ph. D., 1929, prof. physics, U. of K., Lawrence, Kan.
*Kinney, Edward D., B. S., 1930, assoc. prof. and head Dept. Chemical Engineering, U. of K., Lawrence, Kan.
*Kitchen, Mary E., B. S., 1924, R. R. 1, box 38A, Larned, Kan. (Librarian Phillips Univ., Enid, Okla.)

*Lane, H. H , Ph. D., 1929, prof. and head Dept. Zoology, U. of K., Lawrence, Kan.
*Landrum, Claude G., A. B., 1930, grad. student, U. of K., Lawrence, Kan.
*Larson, Mary E., A. M., 1925, asst. prof. zoology, U. of K., Lawrence, Kan.
*Larson, Iva, M. S., 1928, asst. genetics, K. S. A. C., Manhattan, Kan.
*Latimer, Homer B., Ph. D., 1928, prof. anatomy, U. of K., Lawrence, Kan.
Latshaw, W. L., 1923, 1929, assoc. prof. chemistry, K. S. A. C., Manhattan, Kan.
*Lawson, Paul B., Ph. D., 1919, prof. entomology, U. of K., Lawrence, Kan.
*Lehman, Roy P., A. B., 1928, geologist, Sinclair Oil Co., Box 52, Ellis, Kan.
Leist, Claude, M. A., 1929, assoc. prof. biology, K. S. T. C., Pittsburg, Kan.
*Lindahl, Glenn W., B. S., 1928, supt. schools, Munden, Kan.
*Lindley, E. H., Ph. D., LL. D., 1923, chancellor, U. of K., Lawrence, Kan.
*Linsdale, Jean M., Ph. D., 1928, research assoc., California Museum Vertebrate Zoology, Univ. California, Berkeley, Cal.
*Long, W. S., Ph. D., head Chemstry Dept., Kansas Wesleyan, Salina, Kan.
*Lyon, Eric, M. S., 1926, assoc. prof. physics, K. S. A. C., Manhattan, Kan.
*Lyon, Jeanne, M. S., 1930, inst. physiology and hygiene, M. S. C. W., Columbus, Miss.
*Matthews, Wm. H., B. S., 1930, assoc. prof. physics, K. S. T. C., Pittsburg, Kan.
*Maus, Pearl M., M. S., 1927, Auburn, Kan.
*Maxwell, Geo. W., M. S., 1929, asst. prof. physics, K. S. A. C., Manhattan, Kan.
*McDonald, Clinton C., Ph. D., 1928, prof. botany, Wichita Univ., Wichita, Kan.
*McKinley, Lloyd, Ph. D., 1928, Wichita Univ., Wichita, Kan.
*McMasters, Belle M., B. S., 1928, student, K. S. T. C., 820 Cottonwood St., Emporia, Kan.
*Melchers, Leo Edward, M. S., 1918, head Dept. Botany and Plant Pathology, K. S. A. C., Manhattan, Kan.
*Menninger, Karl A., M. D., 1919, physician, Mulvane Bldg., Topeka, Kan.
*Messmore, H. E., E. M., 1929, grad. asst. Chemistry Dept., U. of K., Lawrence, Kan.
*Michner, John, M., M. S., 1925, instr. chemistry, Wichita High School, Wichita, Kan.
*Miller, A. W., M. S., 1928, instr. chemistry, Hutchinson Junior Col., Hutchinson, Kan.
*Miller, Edwin Cyrus, Ph. D., 1918, prof. botany, K. S. A. C., Manhattan, Kan.
*Miller, R. F., Ph. D., 1928, prof. physics, Col. Emporia, Emporia, Kan.
*Miller, O. M., B. S., 1930, science teacher, Central Col., McPherson, Kan.
*Mohler, R. E., 1929, head Agr. Dept., McPherson Col., McPherson, Kan.
*Moore, Fleming G., Ph. D., 1927, prof. physics, Washburn Col., Topeka, Kan.
*Morris, Mary Hope, M. S., 1929, Hutchinson Junior Col., Hutchinson, Kan.
*Morrison, Beulah May, Ph. D., 1928, asst. prof. psychology, U. of K., Lawrence, Kan.
*Nash, Bert A., Ph. D., 1930, prof. ed. psychology, K. S. T. C., Emporia, Kan.
*Neher, S. J., A. B., 1930, inst. botany, Covert, Kan.
*Newman, Edwin B., A. B., 1930, instr. psychology, U. of K., Lawrence, Kan.
*Nininger, H. H., 1921, McPherson Col., McPherson, Kan.
*Nolf, L. O., M. S., 1928, John Hopkins Univ., Baltimore, Md.
*Noll, W. C., A. M., 1929, prof. biology, Col. Emporia, Emporia, Kan.
*Oman, A. E., M. F., 1928, asst. biologist, U. S. Biological Survey, 136 E. 12th St., Dallas, Texas.
*Painter, Reginald, Ph. D., 1927, asst. prof. entomology, K. S. A. C., Manhattan, Kan.
*Parker, J. H., Ph. D., 1918, prof crop improvement, Dept. Agronomy, K. S. A. C., Manhattan, Kan.
Parker, Ralph L., Ph. D., 1926, 1929, prof. entomology and apiculture, apiarist, K. S. A. C., Manhattan, Kan.
*Payne, Sister Anthony, A. M., 1930, grad. student, U. of K., Lawrence, Kan. (Atchison, Kan.)
*Payne, Nellie M., Ph. D., 1920, scientific staff, Biological Abstracts, Zoological Lab., 38th and Woodlawn Ave., Philadelphia, Pa.

Perkins, Alfred T., 1925. 1929 asst. prof. chemistry, K. S. A. C., Manhattan, Kan.
*Perkins, Theodore, A. B., 1930, grad. student, U. of K., Lawrence, Kan.
*Perrine, Irving, Ph. D., 1921, oil operator, geologist, 1619-21 Petroleum Bldg. Oklahoma City, Okla.
*Peterson, J. C., Ph. D., 1919, prof. education, K. S. A. C., Manhattan, Kan.
Pittman, Martha S., M. S., 1925, prof. food economics and nutrition, K. S. A. C., Manhattan, Kan.
*Potter, Isabel, M. S., 1926, instr. biology, Winthrop Col., Rock Hill, S. C.
*Pretz, Paschal H., M. S., 1930, prof. physics, St. Benedict's Col., Atchison, Kan.
*Prickett, Marjorie, B. S., 1930, grad. student zoology, K. S. A. C., Manhattan, Kan.
Prince, S. Fred, 1928, biological artist, K. S. A. C., Manhattan, Kan.
*Putnam, Clyde L., 1930, K. S. T. C., Hays, Kan.
*Rankin, Roy, M. A., 1919, chemistry and chairman Sci. Div., K. S. T. C. Hays, Kan.
*Ratzlaff, Abe K., A. B., 1930, asst. instr. anatomy, U. of K., Lawrence, Kan.
*Readio, Philip A., M. S., 1928, asst. prof. entomology, U. of K., Lawrence, Kan.
*Reed, H. B., Ph. D., 1930, prof. psychology, K. S. T. C., Hays, Kan.
Reinisch, E. F. A., 1917, landscape artist, City Park Dept., City Hall, Topeka, Kan.
*Richardson, Helen, 1930, student, K. S. T. C., Emporia, Kan.
*Richey, Ross, 1930, student, K. S. T. C., Emporia, Kan.
*Robinson, W. J., M. S, 1928, prin. High School, Lincoln, Kan.
*Rouse, J. E., M. S., 1928, prof. agric., K. S. T. C., Hays, Kan.
Royer, W. D., A. B., 1927, instr. biology, Wichita High School East, Wichita, Kan.
Rudle, N. H., 1929, science teacher, High School, Hays, Kan.
*Russom, Vaughn, W., A. B., 1928, field geologist, box 543, Wichita, Kan.
*Rust, Mrs. Lucille, M. S., 1928, assoc. prof. education, K. S. A. C., Manhattan, Kan.
Sager, Howard W., B. S., 1928, supt. High School, Montrose, Kan.
*Salmon, S. C., M. S., 1926, prof. farm crops, K. S. A. C., Manhattan, Kan.
*Sarracino, John, 1928, Emporia, Kan. (Valdez, Col.)
*Savage, David A., B. S., 1930, asst. agronomist, Branch Expt. Sta., Hays, Kan.
*Sayre, Claude E., Ph. D., 1924, Minister M. E. church, Mt. Pleasant, Iowa.
*Schaefer, Helen, 1930, student K. S. T. C., Emporia, Kan.
*Schoewe, Walter H., Ph. D., 1925, assoc. prof. geology, U. of K., Lawrence, Kan.
*Schovee, Joseph C., 1928, asst. eng. A. T. & S. F. R. R., 1235 Boswell Ave., Topeka, Kan.
*Schrammel, H. E., Ph. D., 1929, prof. psychology, K. S. T. C., Emporia, Kan.
*Schumann, Margaret, M. A., 1922, technichian Anatomy Dept., U. of K., Lawrence, Kan.
*Seaton, Roy A., M. S., 1928, dean Div. Engineering, K. S. A. C., Manhattan, Kan.
*Setty, Laural R., 1928, Emporia, Kan.
Sewell, M. C., Ph. D., 1928, assoc. prof. soils, Agronomy Dept., K. S. A. C., Manhattan, Kan.
*Shadd, Geo. C., 1921, dean Engineering School, U. of K., Lawrence, Kan.
*Shaw, Hubert, deG., Ph. D., 1928, St. Benedicts Col., Atchison, Kan.
Shaw, Ruth, M. A., 1928, asst. instr. zoology, U. of K., Lawrence, Kan.
*Showalter, Donald F., M. A., 1928, supt. schools, Lebanon, Kan.
*Shuler, Fred E., Ph. C., 1929, student, U. of K., Lawrence, Kan.
Sites, Blaine E., B. S., 1930, teacher High School, Salina, Kan.
*Smith, Roger C., Ph. D., 1921, prof. entomology, K. S. A. C., Manhattan, Kan.
*Smitz, Benjamin L., Ph. D., 1930, assoc. food analyst, K. S. A. C., Manhattan, Kan.
*Spencer, D. H., 1925, Pharmacy Dept., U. of K., Lawrence, Kan.
*Sperry, Arthur B., B. S., 1917, 1922, prof. geology, K. S. A. C., Manhattan, Kan.
*Stanley, George, B., M. D., Ph. D., 1928, physician and surgeon, Windsor, Hosp., Windsor, Col.
*Steen, Robert A., 1928, student, K. S. T. C., Emporia, Kan.
*Sternberg, George F., 1928, field vertebrate paleontologist, K. S. T. C., Hays, Kan.
*Stevens, William C., 1890, head Botany Dept., U. of K., Lawrence, Kan.
Stogsdill, J. W. E., A. B., 1929, East High School, Wichita, Kan.

*Stoland, O. C., Ph. D., 1918, prof. physiology and pharmacology, U. of K., Lawrence, Kan.
*Stoltz, Martha, M. S., 1928, asst. prof. biology, Ottawa Univ., Ottawa, Kan.
Stone, J. R., 1923, 1929, Quartermaster's Office, U. S. Disciplinary Barracks, Ft. Leavenworth, Kan.
*Stouffer, E. B., Ph. D., 1929, dean Grad. School, U. of K., Lawrence, Kan.
*Stranathan, J. D., Ph. D., 1930, assoc. prof. physics, U. of K., Lawrence, Kan.
*Studt, Charles W., M. S., 1928, chief geologist, Union Gas Co,. Independence, Kan.
Sumpter, Helen, 1929, box 354, Hillsboro, Kan.
*Sutter, L. A., M. D., 1923, physician, 601 First National Bank Bldg., Wichita, Kan.
*Swanson, Arthur F., M. S., 1926, agronomist, Ft.. Hays Exper. Sta., Hays, Kan.
*Taft. Robert. Ph. D., 1923, 1929, assoc. prof. chemistry, U. of K., Lawrence, Kan
*Taylor, Mary Fidelia, A. M., 1930. asst. prof. household economics, K. S. A. C., Manhattan, Kan.
*Taylor. Edward H., Ph. D., 1928, assoc. prof. zoology, U. of K., Lawrence, Kan.
*Thompson, D. Ruth, M. A., 1928, prof. chemistry, Sterling Col., Sterling, Kan.
*Thurow, Mildred B., M. S., 1930, prof. home economics, McPherson Col., McPherson, Kan.
*Tissue, Kathryn Anne, M. S., 1929, head Dept. Home Economics, Ottawa, Univ., Ottawa, Kan
*Treece, E. Lee, Ph. D., 1929, assoc. prof. bacteriology, U. of K., Lawrence, Kan.
*Truesdell, B. W., B. S., 1923, head Science Dept. High School, (706 N. Lawrence Ave.) Wichita, Kan.
*Tucker, Ruth E., M. S., 1928, inst. food economics and nutrition, K. S. A. C., Manhattan. Kan.
*Wade, Joseph S., 1927, assoc. entomologist, U. S. Dept. of Agric., Washington, D. C.
*Walker, M. V., 1929, zoology, K. S. T. C., Hays., Kan.
*Walters. Orville, A. B., 1928, Garber Tool Co., Garber, Okla.
*Warren, Don C., Ph. D., 1925, assoc. prof. poultry husbandry, K. S. A. C., Manhattan, Kan.
Watson, G. N., Ph. C., B. S., 1928, manager, Watson Lab., Independence, Kan.
*Weatherly, Mrs. J., 1929, A. M., prof. psychology, K. S. T. C., Hays, Kan.
*Webb, Frank A., 1930, research assoc., Bureau of Standards, National Lighting Co., Arkansas City, Kan.
*Webb, Paul, 1930, research assoc., Bureau of Standards, National Lighting Co., Arkansas City, Kan.
*Weber, Clarence J., Ph. D., 1930, res. chemist, 4211 Booth St., Kansas City, Kan.
*Weber, Clement, Catholic priest, box 186, Selden, Kan.
*Weber, Louis R., 1929, A. M., head Physics Dept., Friends Univ., Wichita, Kan.
*Wedel, P. J., A. M., 1926, chemistry, Bethel Col., Newton, Kan.
*Weeks, Elvira, Ph. D., 1927, asst. prof. chemistry, U. of K., Lawrence, Kan.
*Weidlein, Edward Ray, Sc. D., 1911, director Mellon Inst. Industrial Research, Pittsburgh, Pa.
Weidlein, W. D., B. S., 1928, prof. physics, Hays, Kan.
Wells, J. R., 1920, 1929, K. S. T. C., Pittsburg, Kan.
*Wener, Henry, M. S., 1930, asst. prof. chemistry, U. of K., Lawrence, Kan.
*Wheeler, Raymond H., Ph. D., 1930, head Psychology Dept., U. of K., Lawrence, Kan.
*Whitcomb, S. L., A. M., Hon. Litt. D., 1926, prof. English, U. of K., Lawrence, Kan.
*Wimmer, Edward J., Ph. D., 1928, asst. prof. zoology, K. S. A. C., Manhattan, Kan.
*Woke, Paul A., 1930, senior Ottawa U., Ottawa, Kan.
*Wood, Robert E., M. S., 1930, chemistry, H. S., Lawrence, Kan.
*Woodward, Parke, M. D., 1930, asst. prof. physiology, U. of K., Lawrence, Kan.
*Wooster, L. D., Ph. M., 1924, prof. biological sciences, K. S. T. C., Hays, Kan.
*Worden, Alice R., B. S., 1928, K. S. T. C., Emporia, Kan.
*Wright, Lennel I., B. A., 1930, instr. anatomy, U. of K., Lawrence, Kan.
Wunsch, W. A., B. S., 1927, county extension agent, Carlsbad, N. M.
*Yoder, J. J., LL. D., 1926, prof. sociology, McPherson Col., McPherson, Kan.
*Zinszer, Harvey A., Ph. D., 1930, prof. physics and astronomy, K. S. T. C., Hays, Kan.

SIXTY-SECOND ANNUAL MEETING

OF THE

KANSAS ACADEMY OF SCIENCE

Kansas State Teachers College

Hays, April 17-19, 1930

OFFICERS FOR 1929-1930

Wilson B. Wilson, Ottawa ------------------------------ President
Hazel E. Branch, Wichita ------------------- First Vice-President
Wm. M. Goldsmith, Winfield --------------- Second Vice-President
Ray Q. Brewster, Lawrence ---------------------------- Treasurer
George E. Johnson, Manhattan ------------------------ Secretary
L. D. Havenhill, J. W. Hershey, E. R. Wood, and R. L. Parker:
Additional Members of the Executive Council

PROGRAM

THURSDAY, APRIL 17, SCIENCE HALL

8:30 p. m. "Haiti Marches On." A four-reel motion picture film made by the U. S. Marine Corps and accompanied by comments by Dr. Roger C. Smith, K. S. A. C. (Under auspices of the Science Club, K. S. T. C., Hays. Members of the Academy are invited to be guests of the Science Club for this meeting.)

FRIDAY, APRIL 18, SCIENCE HALL

9:00 a. m. Announcements and business.

9:15 a. m. General Papers.

1:30 p. m. Section programs:
a. Biology.
b. Chemistry and Physics.
c. Psychology.

4:30 p. m. Trip to Hays Branch of the Kansas State Agricultural Experiment Station.

6:00 p. m. Banquet. Presidential Address: "The Kansas Academy of Science—Its Position and Mission."
William B. Wilson, Ottawa University.

8:15 p. m. Address: "Naturalist Around the World".
Dr. T. D. A. Cockerell, University of Colorado.
(Under the joint auspices of the Academy and of the Kansas State Teachers College at Hays.)

SATURDAY, APRIL 19, SCIENCE HALL

8:15 a. m. General Papers and Business.

12:00 m. Adjournment. Meeting of the new Executive Council.

PAPERS SUBMITTED FOR THE SIXTY-SECOND MEETING

GENERAL PAPERS

Friday, April 18, 1930

1. Scientific value of carbonic acid. Lyman C. Wooster.
2. Some new or unusual diseases of wheat in Kansas. C. O. Johnston.
3. Cacao bean and its products. I. Historical Ruth Moore and A. W. Barton. II. Chocolate and Elimination. Arthur W. Barton.
4. A convenient and inexpensive system of water thermostats. Robert Taft.
5. The Covert aerolite, a new Kansas find. H. H. Nininger.
6. The fall in temperature in ground squirrels entering a state of hibernation. Geo. E. Johnson.
7. (a) Motion picture film on synthetic diamonds. (b) How diamonds are mined in South Africa. J. Willard Hershey.
8. Some recent results of wheat breeding in Kansas. John H. Parker .
9. Recent developments in the importance and control of the large roundworm of chickens. J. E. Ackert.
10. The early embryology of the rabbit. P W. Gregory.
11. Heritable bad temper in rabbits. Heman L. Ibsen.
12. Habit interference in very young white rats. O. W. Alm.
13. Summation and subtraction of brightness in binocular perception. H. R. De-Silva and S H. Bartley.
14. General and specific factors in the K. S. A. C. freshman tests. Mary Frances White. (Introduced by J. C. Peterson.)

MEETINGS OF SECTIONS—BIOLOGY

Friday, April 18, 1930

1. Observations on the segmentation of the living eggs of six species of Nudibranchia. Mary T. Harman.
2. What moving forces are found in the follicles of the Orthoptera testes. W. J. Baumgartner.
3. The turning of the sperm in the testis of the grasshoppers. C. J. Landrum. (Introduced by W. J. Baumgartner.)
4. The centriole in the germ cells of the duck. J. F. Barker. (Introduced by W. J. Baumgartner.)
5. (a) Botanical notes, 1929. (b) Ranunculus abortivus f. giganteus, a new form from easetrn Kansas. Frank C. Gates.
6. Plants of Clay County, Kansas. Clement Weber.
7. The effect of protein levels on the growth of fish. Marion L. Campbell.
8. The effect of protein in different foods on growth of fish. Bernice Harper. (Introduced by Edward J. Wimmer.)
9. Some anatomical features of Sorbopyrus. Alma Hortleder.
10. Microchemical tests in species of Hydrangea. Geo. W. Burkett.
11. Keys to Viburnum from anatomical characters. Edna Old.

12. Notes on the comparative anatomy of Ribes species. James C. Bates.
13. Lipase activity in Aspergillus niger and Penicillium glacucum under varying conditions. Gertrude Laing.
14. Distinctive anatomical features of Pyrus species. Vera Kanode.
(Papers 9-14 are introduced by W. C. Stevens.)
15. Silphium lacinatum greets the spring. W. C. Stevens.
16. Further studies on the resistance of chickens to subsequent infection of round worm, Ascaridia lineata (Schneider). G. L. Graham. (Introduced by J. E. Ackert.)
17. Studies on the viability of Ascaridia lineata eggs. G. E. Cauthen (Introduced by J. E. Ackert.)
18. Relation of number of nematode eggs swallowed to the degree of infestation. J. E. Ackert, L. O. Nolf and G. L. Graham.
19. A case of hermaphroditism in the dogfish, Squalus acanthias. Geo. E. Johnson.
20. Laboratory reproduction studies on the ground squirrel, Citellus tridecemlineatus. Nelson J. Wade. (Introduced by Geo. E. Johnson.)

CHEMISTRY AND PHYSICS

Friday, April 18, 1930

1. On disubstituted thiohydantoins. Walter S Long.
2. New Iodine derivatives of diphenyl-ether. Ray Q. Brewster.
3. Preliminary report on the thermo- and actino-electric properties of Molybdenite. Otis Johnson. (Introduced by Harvey A. Zinszer.)
4. A simple relationship between the melting and boiling points of liquids. Robert Taft and Jesse Stareck.
5. The effect of light on the growth of banded precipitates of mercuric iodide. Robert Taft and John W. Hill.
6. Lyophilic colloids in liquid ammonia, II. Robert Taft.
7. The influence of gelatin upon the Cu-Cu++ electrode potential. Robert Taft. and Harold Messmore.
8. The viscosities of Gum Arabic-water systems. Robert Taft and Lloyd Malm
9. Mathematical curves with different percentage of mixtures of nitrogen and oxygen upon animal life. J. Willard Hershey.
10. Electron-atom collision effects in mercury vapor. Castle W. Foard.
11. Methods of instantaneous photography. Harvey A. Zinszer.
12. A study of the striated spark. Laurence L. Cruise. (Introduced by Harvey A. Zinszer.)

PSYCHOLOGY

Friday, April 18, 1930

1. Psychology and the laws of dynamics. Raymond H. Wheeler.
2. The relation between entrance test ranking and persistence in college attendance. H. E. Schrammel.
3. Symmetry and visual memory. F. T. Perkins.
4. Some motor effects of affective-stimuli. D. F. Showalter.
5. A new device for use in teaching, testing and research in learning. J. C. Peterson.
6. Comparative values of three tests in mechanical aptitude. Dale Snider. (Introduced by J. C. Peterson.)
7. A group experiment in incidental learning. Raymond Patterson. (Introduced by J. C. Peterson.)
8. Analysis of practice of 100 schools of education and teachers colleges with respect to their uses of entrance tests. Bert A. Nash.
9. Results of giving tests in arithmetic. Mrs. Josephine Weatherly.
10. The psychology of handwriting. W. H. Gray.
11. An analysis of learning curves. J. B. Stroud.

GENERAL PAPERS AND BUSINESS

Saturday, April 19, 1930

1. Recording action currents of the brain. S. H. Bartley and E. B. Newman.
2. The more important insect pests of Haiti. Roger C. Smith.
3. Trailing two "herds" of three-toed horses. M. V. Walker
4. Development of external form of the guinea pig (Cavia cobaya) between fifteen and twenty-one days of gestation. Mary T. Harman and Marjorie Prickett

5. Utilization by normal adult subjects of the calcium and phosphorus in raw milk and ice cream. Myra T. Potter and Martha Kramer
6. The effect of ovariectomy and of corpus luteum extracts on pregnancy in rats. Mrs. Joanna S. Challans.
7. The effect of perspiration on weighted and unweighted silk. Esther Bruner and Julia Southard.

PAPERS TO BE READ BY TITLE

1. Archeological notes on the Fort Apache region, Arizona. Albert B. Reagan.
2. Food requirements of Dendroides canadensis Lec. Nellie M. Payne.
3. Additions to the fungous flora of Kansas. Elam Bartholomew.
4. Selenite crystals as criteria of wind action. Walter H. Schoewe.
5. Oligocene fossil eggs. M. V. Walker.
6. The importance of the sacro-iliac subluxation; a study in neurology. W. T. Corey.

MINUTES OF THE SIXTY-SECOND ANNUAL MEETING

The sixty-second annual meeting of the Kansas Academy of Science was called to order by President William B. Wilson at 9:00 a. m., April 18, 1930. Following announcements by the president, by the secretary and by Prof. Roy Rankin and Dr. A. W. Barton, both of the local committee, the following committees were appointed:

Program: Gates, Agrelius.

Auditing: Baumgartner, Havenhill.

Resolutions: Harman, Branch, Nininger.

Necrology: Hershey, R. C. Smith, White.

Nominating: Rankin, Stevens, Yates.

Membership committee: W. B. Wilson chairman, L. I. Wright, H. E. Schrammel, Nora Dalby, J. A. Yates, J. Breukelman, F. G. Moore, P. Albright, H. E. Crow, C. C. McDonald, W. C. Noll, H. H. Nininger, G. E. Johnson (ex-officio).

The program was carried out as printed. The papers were given in the order listed, with almost none omitted.

The executive council met at a noon luncheon on April 18, to discuss plans for organization of the different sections of the Academy. Those present were: Wilson, Branch, Johnson, Hershey, Havenhill (also as chairman of the Chemistry-Physics section in 1929) and J. C. Peterson (as chairman of the Psychology section in 1929). The general policy developed was that section programs be limited to Friday afternoon of the usual day and a half session of the Academy, but that Saturday afternoon might be used for section programs also. When section papers become too numerous to be given in a half-day it was suggested that the sections could be further subdivided for the half-day program, but that two half days be saved for the general program and business. It was recommended that sections generally organize only to the extent of electing a chair-

man, whose duties would be to preside at the sectional meeting and who could if he chose arrange the section program for the next meeting in consultation or through correspondence with the Academy secretary. The section chairman would also represent the section on the Academy council. Dr. Peterson stated that the Psychology members of the Academy might wish to organize a society as a section of the Academy, but in such a way as to remain distinctly within the Academy.

The annual business meeting of the Academy was held in the forenoon of April 19, with President Wm. B. Wilson in the chair. The report of the secretary was called for and given.

Report of the Secretary

Publication: The printing of Volume 32 of the Transactions was awarded to the Kimball Printing Co., Manhattan, after several bids on the work had been received by the publication committee. Eight hundred copies of Volume 32 were printed at the rate of $2.50 a page, and 200 reprints of each paper were printed at the rate of $0.25 a page. Volume 32 was completed and in the mails in February 1930. Five hundred copies were delivered to the University of Kansas Library for which the Academy received $441.00.

Membership: To date, April 19, 1930, 51 new members joined the Academy in 1930. Arranged by cities and institutions they are:

Arkansas City: Frank A. Webb, Paul Webb.

Atchison (St. Benedict's College): Paschal H. Pretz.

Covert (High School): S. J. Neher.

Emporia (K. S. T. C.): John Breunkelman, J. P. Drake, Joe Fleming, Paul Jehlik, Bert A. Nash, Helen Richardson, Rose Richey, Helen Schaefer.

Hays (K. S. T. C.): Laurence L. Cruise, Raymond Fryar, Otis Johnson, Clyde L. Putnam, H. B. Reed, Harvey A. Zinszer.

Hays (Expt. Sta.): L. C. Aicher, R. H. Davis, E. W. Johnson, David A. Savage.

Hays (Schoenchen): Bernard J. Brungardt.

Kansas City, Kan.: Wm. Lee Corey.

Lawrence (U. of K.): J. F. Barker, S. H. Bartley, Claude G. Landrum, Edwin B. Newman, Theodore Perkins, Sister Anthony Payne, Abe K. Ratzlaff, Raymond Wheeler, Lennel I. Wright.

Lawrence (High School): Robert E. Wood.

Manhattan (K. S. A. C.): L. E. Conrad, Chas. Dobrovolny, Roy A. Greep, M. J. Harbaugh, Lawrence W. Hartel, H. H. Haymaker, Jeanne Lyon, Marjorie Prickett, Mary Fidelia Taylor.

McPherson (Central College): O. M. Miller.

McPherson (McPherson College): G. N. Boone, C. H. Dresher, Vernon Gustafson, Mildred B. Thurow.

Ottawa (Ottawa University): Paul A. Woke.

Sterling (Sterling College): Castle W. Foard.

Flagstaff, Ariz.: J. C. Clarke.

This list already exceeds by two that of new members last year, when we had a total of 49 new members. On April 19, 1930, 125 old members had paid their dues for 1930, 39 fewer than the total members who paid their dues for 1929 up to the present date. Rebilling of members in arrears will probably make the total paid-up membership equal to or greater than that of last year. Three members have definitely resigned this year and a number of student and some faculty members of the Academy have moved out of the state, most of whom will probably let their membership lapse.

In the absence of the treasurer, who was unavoidably absent, the secretary reported that the funds in the treasury were about $860.00, according to a letter from the treasurer. The president announced that the treasurer's account would be audited at Lawrence and sent to the secretary to be appended to these minutes.

The report of the publication committee regarding the Academy Library was called for and given. After the report had been read a motion was made and carried that it be accepted, placed on file, and that the recommendations in it be approved by the Academy. (See "Section B, The Accepted Plan of Disposal of the Library" in the following report for these recommendations.)

Note: The report of the publication committee follows. After the 1930 meeting of the Academy the report of the committee was submitted to the three institutions concerned and accepted by them. An agreement was drawn up and signed by the institutions and the Academy putting Section B of the report into effect. This agreement is appended to the report as published below in order that the final official arrangements regarding the Academy library may appear in one place in this volume.—Geo. E. Johnson.

REPORT OF THE PUBLICATION COMMITTEE

ON THE DISPOSAL OF THE ACADEMY LIBRARY AND THE CONTINUANCE OF PUBLICATION OF THE TRANSACTIONS

A. Meeting of Committee—Preliminary Plans

A meeting of the Publication Committee was held at the Watson Library of the University of Kansas December 26, 1929, to consider the matter of disposal of the Academy Library. Baumgartner, Gates, Rankin and Johnson were the members of the committee present. Librarian C. M. Baker of the University informed the committee that the University could pay very little for the library if it were to purchase it. He also stated that the University would probably not renew the arrangement of the past two years whereby it paid not to exceed $500.00 a year for 500 copies of the annual volume of the Academy. Of other methods of disposal of the library considered by the committee, direct sale to a book dealer presented difficulties since many of the volumes in the Academy Library had been bound by the state printer. A division of the library among the five state schools was then considered, and in order to secure some funds for publication it was decided to ask each of these institutions to bid on the different items on the Academy exchange list. The institution bidding the highest on an item was to receive that exchange for a period of ten years as well as all the back numbers present in the Academy library and would receive a copy of the annual volume of the Academy Transactions each year for ten years wherewith to make the exchange. For this it was to pay the Academy the amount bid each year for ten years.

Bids on these exchanges were received from the University and from the State

participation in the division of the library that would be satisfactory to them. He also asked if these institutions would offer to buy the entire library. To this all replied in the negative.

B. The Accepted Plan of Disposal of the Library

Another proposition which involved payment of $200 a year by the University, of $200 a year by the State Agricultural College, and of $100 a year by the State Teachers College at Hays for a ten year period was favorably acted upon by each of the three institutions. This involved a division of the library in proporion to the amount paid to the Academy, the exact division to be made by the librarians of the three institutions. It also involved giving one copy of the Transactions each year for each dollar received from each of the three institutions during the ten year period. Some details as to the division of the past volumes of the Transactions still on hand remain to be agreed upon by the Academy and the participating schools, the committee suggesting that the Academy retain possession of one-third of each issue of the Transactions now on hand for purposes of sale to members and to high schools and colleges of the state, giving the University and the Agricultural College each 40 per cent and Hays 20 per cent of the remaining volumes. The University is especially desirous of securing certain early bound volumes (about 160) in the Academy library to fill its own sets This list was requested in payment for work on the library and payment for past two years, but the University would pay extra for these in order to secure the entire list. Kansas State Agricultural College desires 250 copies of the Transactions instead of the 200 which our plan involved. The committee therefore suggest that the University be given the entire list of about 160 volumes requested free. and instead of charging the University more than $200 a year allow K. S. A. C. 50 extra copies of the new volumes of the Transactions (total of 250) and the Teachers College at Hays 25 extra copies (total 125), if these institutions request that number.

It was also suggested that K. S. A. C. be requested to provide some extra room for shelving the surplus stock of the new volumes of the Transactions partly on account of the extra copies allowed.

Extra copies beyond those agreed upon may be secured by the libraries by special arrangement with the Academy previous to publication of a particular volume.

The Academy agrees to make a permanent deposit or give parmenent possession of the portion of the Academy library received by each school, and agrees that no question of title shall be raised after such division. The Academy also agrees that the three institutions participating in this division shall have exclusive exchange rights which the three librarians shall divide in an equitable manner agreeable to all three. New exchanges may be secured in a manner agreed upon by the three librarians.

The librarians will be expected to make a brief annual report to the Academy concerning number of old exchanges and names of new exchanges secured during the year preceding the annual meeting.

The librarians are also urged to be active in securing new exchanges and in keeping the present exchanges in order that the Academy Transactions may receive wide distribution.

Frank C. Gates — Wm. J. Baumgartner

Martha Stoltz — Roy Rankin

George E. Johnson, Chairman

The Agreement

We, the undersigned, representing the University of Kansas, the Kansas State Agricultural College, the Kansas State Teachers College at Hays, and the Kansas Academy of Science, do hereby agree that our respective institutions and the Academy will carry out the provisions given in that part of the above report entitled "Section B. The Accepted Plan of Disposal of the Library".

It is agreed by the representatives of the Academy that the annual volume of Transactions shall approximate Volume 32 in all essential features, so that the exchange value of the future volumes shall not be materially lowered because of marked changes in policy as to publication. It is also agreed that the annual report by the librarians concerning exchanges shall be invited rather than required by the academy.

For the Academy by the Executive Council:
Hazel E Branch, President
Roger C. Smith, First Vice-President
Wm. H. Matthews, Second Vice-President
Ray Q. Brewster, Treasurer
Geo. E. Johnson, Secretary
Robert Taft, Wm. B. Wilson, F. U. G. Agrelius, W. A. Barton,
Mary T. Harman, J. C. Peterson, Geo. A. Dean

For the University of Kansas:
E. H. Lindley, Chancellor
Chas. M. Baker, Director of Libraries

For the Kansas State Agricultural College:
F. D. Farrell, President
A. B. Smith, Librarian

For the Kansas State Teachers College at Hays:
W. A. Lewis, President
F. B. Streeter, Librarian

The committee on resolutions presented the following resolutions:

1. That we express our appreciation to President W. A. Lewis, Prof. Roy Rankin, Dr. A. W. Barton, Dr. H. B. Reed, and other members of the faculty of the Kansas State Teachers College at Hays for the hospitality extended the Kansas Academy of Science during its sixty-second annual meeting.

2. That we express our appreciation to the officers of the Academy and to the Science Club and to the staff of the Experiment Station at Hays for providing excellent and varied entertainment during the meeting, and that we express our appreciation to Prof. F. W. Albertson for his efficiency in running the lanterns;

3. That we express our thanks to Dr. T. D. A. Cockerell of the University of Colorado for his interesting reminiscences of a scientist around the world, to Dr. R. C. Smith for his presentation of the moving picture film on Haiti, and to the Webb brothers for their music at the banquet;

4. That the Academy send greetings to Dr. E. H. S. Bailey, Lawrence, to Dr. Ephriam Miller, Pasadena, Calif., to Dr. Warren S. Knaus, McPherson, and to Mr. G. H. Failyer, Manhattan;

5. That we congratulate the Kansas State Teachers College at Hays on the completion of their new Science Hall;

6. That we recognize and express our appreciation to Dr. G. E. Johnson, our secretary, and other members of the committee on publication for their tireless efforts and successful results in securing funds to continue the publication of the Transactions of the Academy and their disposition of the library and the exchanges of the Academy;

7. That we rejoice that the interest has not only kept up but has increased to such an extent that the Academy has formed secions of Chemistry and Physics, Biology, and Psychology, and that the interests of each section is represented on the council by the sectional chairman;

8. That we go on record as favoring a single session for the sectional groups and the retaining of the general meetings.

Mary T. Harman, Hazel E. Branch, H. H. Nininger.

The committee on necrology reported that the Academy had suffered the loss of only one member by death during the past year, and submitted the following obituary as its report:

JAMES WALKER McCOLLOCH (1889-1929)

James Walker McColloch was born at Anthony, Kansas, April 14, 1889, and died at Manhattan, Kansas, November 11, 1929. He lived all his life in Kansas, and his early education was obtained in the Anthony Public Schools. He received the degree of Bachelor of Science from the Kansas State Agricultural College in 1912, and the degree of Master of Science in 1923. He showed marked aptitude for entomological work while an undergraduate student, and in 1910 and 1911 was a special field agent for the Department of Entomology for the college. In 1912 he was made Assistant Entomologist of the Agricultural Experiment Station. In

1918 he was made Associate Professor of Entomology and Associate Entomologist of the Agricultural Experiment Station, and in 1925, Professor of Entomology.

Professor McColloch was a leading economic entomologist and was widely known for his research and investigational work on the chinch bug, Hessian fly, corn earworm, soil insects, plant resistance to insect attack, and other subjects. He was author or joint author of 39 published contributions from the Department of Entomology. Some of these publications were large bulletins representing the work of a period of years. He was editor of the Journal of the Kansas Entomological Society from the beginning of the journal, and editor of one of the divisions of entomology for Biological Abstracts from the beginning volume until his death.

Professor McColloch was an active member of the Kansas Academy of Science from 1911 until his death. He served as chairman of the park or ecological committee, from its origin in 1922. A report written by him has been published in the Transactions, calling attention to localities of striking natural beauty in Kansas which should be preserved as public parks.

The Kansas Academy of Science has lost a willing worker, but one whose life and work reflects the highest credit to it.

J. Willard Hershey, Roger C. Smith

The representative of the Academy on the council of the A. A. A. S. submitted the following report:

Your representative attended the Academy Conference December 27, 1929, at Des Moines and also the daily meeting of the executive council of the A. A. A. S. during the 1929-30 sessions. Twelve representatives from as many academies met with three representatives from the A. A. A. S. The last three were Burton E Livingston, J. McKeen Cattell and Henry B. Ward. The purpose of this conference, which holds one meeting a year in connection with the A. A. A. S. and also keeps the members in touch with each other through mimeographed letters sent out at intervals, is to further the work of academies and to improve cooperation between them and the association.

Dr. Livingston spoke briefly. He referred to the 50c allotment to the academies for each person who is a member of both organizations. He also stated that the association desired to name an association representative to each academy meeting in so far as possible, and suggested that the academies use some of their allotments from the association for the purpose of defraying the speaker's expenses.

A paper on encouragement by the Illinois Academy of Science of scientific endeavor among high school students was read by Louis Astell, a high school teacher in Chicago, who has been a science club sponsor for some years. He stressed the importance of science clubs in which the students do the work of arranging for and carrying out the programs under the guidance of a faculty sponsor. L. J. Thomas, past secretary, and A. C. Walton, present secretary of the Illinois Academy, outlined the high school development of the Academy work in Illinois. Instead of appealing chiefly to high school teachers of science the Academy now has a Junior Academy of Science attended by representatives of various affiliated science clubs in high schools and Junior colleges.

Recommendations:—If the Kansas Academy of Science considers that it would be well to encourage the formation of a Junior Academy of Science as a section of the Academy proper, it would seem advisable to appoint a committee consisting of interested high school teachers to study the matter and take such steps as seem desirable to them and to the executive council of the Academy for the fostering of science clubs in the various high schools and colleges of the state and in building up a program given by representatives of these clubs as a sectional meteing of the Academy.

George E. Johnson.

Dr. Harvey A. Zinszer raised the question why there was lack of support of the Academy by the physicists of the state. He reported that in the Indiana Academy, with a membership of 900, the phy-

sicists and the chemists were very loyal supporters of the Academy. A motion was made that a committee be appointed to investigate the desirability of interesting high school students and teachers in the Academy. After some debate the motion was passed.

The nominating committee presented the following names for officers of the Academy for the year 1930-31: president, Hazel E. Branch; first vice-president, Roger C. Smith; second vice-president, Wm. H. Matthews; treasurer, Ray Q. Brewster; secretary, George E. Johnson; additional members of executive council, Wm. B. Wilson, Robert Taft, A. W. Barton, F. U. G. Agrelius. Nominations from the floor were called for. As none were made the nominees were declared elected.

The retiring president called the president-elect to the chair. At the close of the program another short business session was held. Dr. Wm. J. Baumgartner tendered an invitation from the University for the Academy to meet at Lawrence next year and upon motion this invitation was accepted.

Announcements of chairmen of the different sections were made as follows: Biology, Mary T. Harman; Chemistry-Physics, Robert Taft; Psychology (Kansas Psychological Association), J. C. Peterson; Entomology (Kansas Entomological Society), Geo. A. Dean. Upon motion it was de ided to consider these section chairmen as members of the executive council as recommended by the past council. Dr. R H. Wheeler reported that the Psychologists had organized the Kansas Psychological Association under the by-laws of the Academy, without separate dues, requiring membership in the Academy, and with intention of meeting regularly with the Academy. Prof. H. R. DeSilva is secretary of the Association. The secretary of the Academy reported that the officers of the Kansas Entomological Society elected at its annual meeting already held at Manhattan were: president, G. A. Dean; vice-president, R. H. Beamer secretary, R. L. Parker. He also reported that it was the intention of this society to meet with the Academy at Lawrence next year and to hold their section program on either Friday or Saturday afternoon.

GEORGE E. JOHNSON, Secretary.

Report of the Treasurer

For the Fiscal Year of April 20, 1929 to April 20, 1930

RECEIPTS

1929			
April 30	Balance on Hand	$197.91	
May 15	University of Kansas for Transactions	500.00	
June 15	Sale of Reprints	14.72	
June 17	Dues	57.50	
Nov. 12	Sale of Transactions	2.00	
Nov. 12	Received of A. A. A. S.	15.50	
Nov. 12	Dues	22.50	
Nov. 17	Interest	7.50	
1930			
Jan. 11	Interest	1.88	
Feb. 17	Dues	81.00	
Feb. 17	Sale of Reprints	33.52	
Mar. 3	Dues	1.00	
Mar. 22	Sale of Reprints and Transactions	40.00	
Mar 26	Dues	1.00	
April 12	Sale of Reprints	20.45	
April 12	University of Kansas for Transactions	441.00	
	Total Receipts		$1,437.48

DISBURSEMENTS

1929			
June 17	Misc. Expense (printing, speakers, etc.)	$ 57.08	
Nov. 12	Misc. Expense (cuts)	19.00	
1930			
Feb. 17	Misc. Expense (cuts, stamps, etc.)	77.55	
Feb. 21	Hope Murray (typing)	6.60	
Feb. 21	Kimball Printing Co.	130.25	
April 12	Postage	.42	
April 12	Kimball Printing Co.	285.00	
	Total Expense		$575.96
April 23	BALANCE FORWARD		$861.52

PAPERS AND ABSTRACTS

SIXTY-SECOND ANNUAL MEETING, HAYS, 1930

BOTANICAL NOTES, 1928-1929[1]

1. Contribution No. 307 from the Dept. of Botany & Plant Pathology, Kansas State Agricultural College, Manhattan, Kansas.

FRANK C. GATES
Kansas State Agricultural College, Manhattan, Kansas

Notes in 1928

The autumn of 1928 was characterized by the unusually large number of trees that normally have fruit being without it. The reason was primarily a late frost in spring which hit the following severely: Acer platinoides, Acer nigrum, Gleditsia triacanthos, Gymnocladus dioica, Acer ginnala, Acer negundo (much less).

On the other hand a few trees, particularly Sophora japonica, were characterized by an unusually large number of fruits.

There was a great deal of insect work on vegetation during the season of 1928.

Without doubt the most interesting occurrence of the year was that on October 11, 1928, there were upwards of 30 branches of Aesculus glabra in blossom on the campus. While plants such as lilacs, violets, and others not uncommonly have a fall blossoming, such an occurence in Aesculus has never been recorded. The flowers did not completely out in a large inflorescence, but the stamens extruded and the pistil was visible. Later in the fall the flower buds of Acer saccharinum swelled to a separation of the scales, but no plants were seen in actual blossom .

Fasciations were noted on a tree of Ailanthus altissimisa. The fasciation in this case had taken place in the growing season of 1927 and included about 1.5 meters of the tip. All of this part died back in the winter of 1927-1928. Faciation was also noticed in a bush of Callicarpa purpurea. Neither of these two cases to my knowledge has been reported before.

The growing season of 1928 was more conducive to vegetable growth than to seed production. It was noteworthy for extending to an

equal date, the latest first killing frost, November 2, the same as 1927. Very cold weather and a great deal of snow started January 1 and maintained the ground cover longer than any recent year. The first migrant robins found great difficulty in getting sufficient food and a flock of about 40 cleaned the seeds rather thoroughly from a tree of Sophora japonica. According to the Biological Survey this is only the second time that any bird has been recorded eating the seeds of this plant. The plant has saponin in it and is not agreeable to the taste.

The Department of Botany is cooperating with Miss Lois Gould of Norman, Oklahoma, who two years ago started a phenological study of plants in the prairie region.

An account of an unusual head of sorghum (Blackhull kafir) with greatly proliferated spikelets was written up with H. H. Laude for publication in the Botanical Gazette. The head was found in a field of Blackhull kafir by D. L. Roser, Burlington, Coffey County, Kansas, October 19, 1928. Nothing like it has been previously reported. Instead of the normally fertile spikelet, a series of about 38 (38-41) closely inserted scales "lemmas" entended upwards from between the glumes, without any trace of stamens or pistils.

Notes in 1929

The year 1929 was characterized by the extreme lateness of the spring with no check to the development of the prairies, once they began their development. Among the interesting items that came to our attention during the year were the very heavy crop of seeds on Thuja occidentalis on the campus of the Kansas State Agricultural College and the entire absence of fruit on Sophora japonica for the first time since the tree began bearing fruit.

During the year past, P. A. Rydberg of the New York Botanical Garden spent tht greater part of a month in collecting, principally in southern and western Kansas. In the state we have had collections principally from Clement Weber in Clay County, S. V. Fraser in Cloud County, Anna A. Jacobs in Cherokee County, and Mrs. C. E. Rogers in Woodson County (1928).

A chimera on Quercus inbricaria on the campus of Kansas State Agricultural College is worth calling to your attention. It takes the form of lighter green leaves on about one-fifth of the crown of the tree, extending upwards from the base. The tree appears perfectly normal otherwise, but this lighter green sector is very conspicuous for quite a distance when one is on that side of the tree.

Whorled buds were found for the first time in Cornus asperifolia in the vicinity of Manhattan.

The case of hog poisoning by Rudbeckia laciniata in the vicinity of Frankfort, Kansas, was brought to my attention by the veterinarian, T. Foley. The history of the case is as follows: Hogs which had been penned up and fed were turned loose in a wooded area along a stream near Frankfort in the early part of October, 1929. The vegetation available to the pigs was almost entirely Rudbeckia laciniata. The symptoms were similar to those which Belladonna produces. The mucous membrane became very dry and the animals went into convulsions. A number died. Fencing the animals from access to the Rudbeckia prevented further trouble. However, the further feeding of Rudbeckia resulted in the death of the hog to which it was fed. This plant is known as a poisonous plant, but cases of poisoning by it occur very seldom as it is not usually eaten by stock.

One of the most interesting plants came from Mrs. Rogers near Yates Center, which is so striking that it might well be dignified with a form name: viz., Ranunculus abortivus f. giganteus forma nova described in the following paper.

RANUNCULUS ABORTIVUS F. GIGANTEUS, A NEW FORM FROM EASTERN KANSAS[1]

FRANK C. GATES
Kansas State Agricultural College, Manhattan, Kansas

Similar to Ranunculus abortivus in most particulars, but with the basal leaves exceedingly large, mostly between 8 and 9 cm. in width and between 9 and 10 cm. from the apex to the end of the lobes; crenate, orbicular, the sinus medium broad, about one-third of the whole length of the leaf; stem slightly stoutish, and slightly succulent.

The type specimen, 50 cm. high, collected June 5, 1928, three miles southeast of Yates Center, Kansas, deposited in the herbarium of the Kansas State Agricultural College, Manhattan, Kansas, by Mrs. C. E. Rogers.

As one goes westward, the plants of Ranunculus abortivus tend to be below rather than above the dimensions of the plants in eastern United States, but in the case of this form, under general ecological conditions which do not appear to be other than usual, this very large leafed plant appears; much larger than Fernald's variety eucyclus and somewhat succulent, with a stouter stem.

1. Contribution No. 308 from the Dept. of Botany & Plant Pathology, Kansas State Agricultural College, Manhattan, Kansas.

SOME ANATOMICAL FEATURES OF SORBOPYRUS AURICULARIS

ALMA HORTLEDER
University of Kansas, Lawrence, Kansas

Sorbopyrus is a hybrid between two closely related genera, namely, Sorbus and Pyrus. Its Sorbus parent is S. aria while its Pyrus parent is P. communis, the common pear. In this paper I shall endeavor to compare the most outstanding anatomical features of Sorbopyrus with those of its parents. For the comparison of leaves it was necessary to substitute the Sorbus type for S. aria because I was unable to obtain leaves of S. aria at this time.

In cross section, the general form of the petiole of Sorbopyrus is intermediate between that of the Sorbus type and P. communis. In all three species the epidermis is composed of relatively small cells; however, Sorbopyrus resembles the Sorbus type by having extremely small epidermal cells. From 3 to 6 rows of collenchymatous hypoderm form an entire cylinder around the petioles of each of the species studied. The ground parenchyma cells are similar in all. In P. communis, bundles of bast fibers closely border the phloem on the convex side of the vascular arc and other thinner walled bast fibers border the concave side of the xylem. In Sorbus the bast region is usually continuous and borders only the convex side of the vascular arc, while the concave side of the arc is bordered by thin-walled prosenchymatous cells. The interrupted bast region on the convex side of the vascular arc in Sorbopyrus resembles its Pyrus parent more closely but it differs from both Pyrus and Sorbus in having parenchyma cells interspersed in it. The con cave side of the vascular arc is bordered by thin-walled prosenchyma as in Sorbus. Sorbopyrus differs from both parents by having a starch sheath bordering the convex side of the vascular arc. Sorbopyrus resembles the Sorbus type by having a vascular arc, at the middle of the petiole, composed of a single, bicollateral vascular bundle while the vascular arc of P. communis is composed of a single collateral bundle.

As seen in cross-section, the general form of the midrib of Sorbopyrus is quite similar to that of Sorbus and quite dissimilar to that of P. communis. The epidermal cells are similar in all three species. The collenchymatous hypoderm of P. communis and the Sorbus type are quite similar but Sorbopyrus differs from both parents in having a broad zone of collenchyma beneath both epidermises. Sorbo-

pyrus resembles Sorbus in having bast fibers on only the lower side of the vascular arc, but it differs from both parents in having the fibers arranged in isolated bundles. Both Sorbopyrus and the Sorbus type have thin-walled prosenchyma immediately above the vascular arc while P. communis has bast fibers above its vascular arc.

In general shape, the margin of Sorbopyrus most closely resembles that of P. communis. In depth of epidermis, Sorbopyrus is intermediate between Sorbus and Pyrus. The most outstanding feature in comparing margins is the amount of collenchyma found in them. While collenchyma is usually entirely absent in the margin of the Sorbus type, it is found abundantly in the margins of botth Sorbopyrus and P. communis.

The most outstanding feature in comparing sections of P. communis, Sorbopyrus and S. aria, is the structure of the pith. Both Sorbopyrus and P. communis have a homogeneous pith composed of thick-walled cells filled with starch while S. aria has a heterogeneous pith which is composed of thin-walled empty cells and a few thick-walled cells containing starch and tannin.

In brief, Sorbopyrus resembles the Sorbus type in the following respects.

(1). The bast region is composed of isolated bundles, bordering the
(2). Thin-walled prosenchyma is found on the concave side of the vascular arc of the petiole and midrib.
(3). The vascular bundle of the petiole is bicollateral.
(4). The general shape of midrib cross-sections is similar in both genera.
(5). Thin-walled prosenchyma is found above the vascular arc of the midrib.

Sorbopyrus resembles P. communis in the following respects:

(1). The bast region is composed of isolated bundles, dordering the convex side of the vascular arc.
(2). The general shape of the margin is similar in both species.
(3). Collenchyma is abundant in the margin.
(4). The stems have homogeneous pith.

Sorbopyrus differs from both the Sorbus and Pyrus types in the following ways:

(1). The bundles of bast fibers, bordering the vascular arc, are intersperced with parenchyma cells.
(2). A starch sheath is present on the convex side of the vascular arc of the petiole.
(3). A broad zone of collenchymatous hypoderm is found in the petiole.

SOME NEW OR UNUSUAL DISEASE DEVELOPMENTS ON WHEAT IN KANSAS[1]

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United States Department of Agriculture
and
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In researches on the cause, nature and control of such major diseases of wheat as bunt, stem rust, leaf rust, and foot-rots, the occurrence of certain minor diseases often has been overlooked. There are several diseases of wheat, present in Kansas nearly every year that seldom are mentioned in reports. It is true these diseases usually are of very little economic importance, due to the infrequency of their occurrence or the mildness of their attack. Occasionally, however, one or more of them appear in sufficient severeity to cause alarm among the growers and to result in definite losses. Such a condition occurred in 1929.

The reason for the outbreak of unusual wheat diseases in 1929 lies principally in the abnormal weather conditions of the early spring months. There was an overabundance of rain during April, May, and the first half of June. The spring was late and cool with brief periods of warm humid weather. Wheat made an unusually rank growth in most parts of the state and lodged badly in many localities. Conditions, therefore, were ideal for the development of fungous diseases attacking the leaves, stems, and heads. As a result, several diseases, usually considered of very minor importance in Kansas, suddenly appeared in the role of limiting factors in yield in certain sections.

The diseases that figured most prominently in this unusual situation in 1929 were scab, leaf blotch, crinkle joint, and black chaff. All of these, except crinkle joint, have been known as minor diseases of wheat in Kansas for many years. Crinkle-joint is relatively new in this state, having been under observation only since 1927. Scab, leaf blotch, and black chaff have occasionally been known to cause considerable loss in limited areas in Kansas, but have seldom been reported so widespread as in 1929.

1. Contribution No. 305 of the Department of Botany and Plant Pathology, Kansas State Agricultural College, in cooperation with the Office of Cereal Crops and Diseases, U. S. Department of Agriculture.

Wheat Scab

This disease caused by Gibberella saubinetii (Mont.) Sacc. had never been recorded as a serious disease of wheat in Kansas prior to 1929. It frequently has been reported to occur in a few counties in the southeastern part of the state where the annual rainfall is relatively high. In 1920 the disease was prevalent in Labette and Cherokee counties, where it caused some loss, but was not reported from other counties in quantities greater than a trace. In 1929, however, scab appeared in great abundance in nearly all localities of the eastern half of the state. The disease attained very serious proportions in the counties north of the Kansas and east of the Blue Rivers, but serious damage was noted in many fields in all parts of the state east of Salina, McPherson, and Wichita. The soft red winter varieties of wheat grown in the extreme eastern part of the state seemed to be the most seriously injured, but occasional fields of Blackhull and Turkey, in eastern counties, also were severely injured. In some instances as much as 45 per cent of the heads were blighted Scab infection was not confined to eastern Kansas, of course, and occasional cases of relatively heavy infections were observed as far west as Hays. Many fields in the area between Salina and Hays, and extending northward and southward the full width of the state, contained traces of scab. At Hays, on May 20, the writer observed considerable scab in experimental plots of wheat.

Scab requires for its best development warm humid weather at the time wheat is blooming, and for a considerable period thereafter. Such conditions obtained in Kansas in 1929. Rainfall during May and early June was heavy in the eastern half of the state and temperatures were sufficiently high for good infection. The rains were so distributed that the relative humidity was high in this area for a considerable period during and immediately following blooming of the wheat.

An interesting and important characteristic of the scab organism is that it is not confined to the wheat plant, but is also a parasite on corn. On this host it causes serious losses in the form of seedling blight and loss of stand. The stalks of corn are also attacked by the organism and the fruiting bodies develop and mature on old stalks left in the field during the winter. The fact that it develops equally well on wheat and corn makes it extremely hard to control. When corn follows wheat inoculum is present in the old wheat stubble and when wheat follows corn the old stalks furnish abundant inoculum if the disease was present in the preceding crop. The fact that there was a considerable increase in the acreage of corn in Kan-

in 1928 may partially explain the unusual severity of scab in wheat in 1929. The total corn acreage was the largest since 1917 and 737,435 acres greater than the acreage of corn in 1927. All but one of the 55 counties lying wholly or partially east of a line drawn north and south through the center of the state had larger acreage of corn in 1928 than in 1927. The season of 1928 was also a wet season and rather favorable for the development of the scab organism on corn. It is likely therefore that more scab inoculum than usual was present in the spring of 1929.

The losses from scab are extremely difficult to measure. In many fields 5 to 40 per cent of the heads were attacked, while in others the percentages were small. Only in the most severe infections did the blighted heads completely fail to produce grain. In most cases only half of the spikelets in a head were infected and many such heads produced some grain. In many cases only one or two spikelets were infected and considerable grain was produced. The actual loss in yield is not the only loss, however, for wheat from scab-infected fields is of inferior quality and brings a low price on the market. Much of the 1929 wheat from eastern Kansas reaching the terminal markets has been docked because of the high percentage of kernels with "pink mold" caused by the scab fungus.

Speckled Leaf Blotch

Traces of speckled leaf blotch of wheat can be found in most parts of Kansas nearly every year. The disease is caused by Septoria tritici Desm. and is confined to the leaves of the host plant, although another species, S. nodorum Berk., attacks glumes, leaves and nodes. The speckled leaf blotch was very abundant in Kansas in 1929, while glume blotch was encountered only occasionally.

In most years considerable leaf blotch develops on seedling wheat plants during the rainy periods of early fall. Infection at that time usually is characterized by small roughly circular brown spots which appear on the lowermost leaves and in which many minute black fruiting bodies of the fungus develop. If conditions are favorable the diseased areas gradually increase in number and size until the lower leaves often are severely injured.

The fungus lives over winter on the lower leaves of the wheat seedlings and begins sporulating freely early the following spring. The spores are disseminated principally by rain and thus only nearby leaves are innoculated by the splashing of raindrops carrying pycnospores. Infection therefore progresses gradually from the

bases of the plants upwards. In Kansas speckled blotch is rather severe on the lower leaves of wheat early in the spring. The disease frequently develops rapidly during the rainy periods of April and early May and may be found in abundance on leaves well up towards the tops of the plants at that stage of growth. However, the weather in May usually becomes too dry for the rapid development of leaf blotch, while the wheat plants continue to grow. Thus toward the end of the season leaf blotch seldom is found in abundance on the uppermost leaves. The disease frequently is fairly abundant on the older leaves near the bases of the plants, but the active upper leaves are seldom more than slightly affected. Under such conditions it is obvious that very little damage is done to the wheat crop. The vitality of the plants may have been slightly impaired by early infections on the lower leaves, but such leaves usually are of little importance to the plants in an average field after spring growth has started. Where stands are good, the lower leaves usually are shaded, rapidly becoming etiolated and having little relation to the welfare of the plant.

The usual development of speckled leaf blotch, however, was not followed in 1929. The spring rains which usually become infrequent in May, continued to be frequent during May and early June. Instead of leaf blotch infection declining in May, it actually increased very rapidly, progressing from the lowermost leaves upward until even the flag leaves were heavily infected in many instances. By the first week in June infection had become very severe in fields throughout the eastern half of the state. The seriousness of the disease is reflected in the fact that grain-market news items during May and June frequently mentioned "leaf-spot" as one of the principal factors in the rapid deterioation of the 1929 Kansas wheat crop.

Speckled leaf blotch continued to spread until the crop was nearly mature, unusually heavy infections developed as far west as Hays. The infection in the western half of the state, however, was by no means so heavy as that in central and eastern Kansas. The writer visited several counties of the central part of the state by automobile on May 27, 28 and 29. Nearly every field of wheat entered in Dickinson, Saline, McPherson, Rice, Stafford, Reno, Kingman and Harper counties was found heavily infected with leaf blotch. During the first week in June heavy infections were noted in fields in Cherokee, Crawford, Labette, Neosho, Bourbon, Allen, Shawnee, Riley and Geary counties. On June 20 a moderate infection of leaf blotch was noted in plots of winter wheat at Hays. The development of the disease from Hays westward was abruptly halted by three days of hot winds on June 16, 17 and 18, which dried up most of the leaves of wheat in that area.

The seriousness of the 1929 epidemic of leaf blotch is reflected in the behavior of varieties of wheat growing in the fortieth-acre plots on the agronomy farm at Manhattan. These plots included several standard varieties of both soft red winter and hard red winter wheat, as well as several promising new hybrid selections. The standard varieties and a few of the hybrids were grown in triplicate plots, while most of the hybrids were grown only in single plots. The latter have been developed by the Department of Agronomy, Kansas State Agricultural College, for early maturity and high yielding ability.

The field plots were visited on June 1 and leaf blotch was found severe on leaves in the lower half of most plants, some varieties exhibited a marked chlorotic spotting on the uppermost leaves. On June 6 most of these spots had turned brown and by June 11 pycnidia were abundant in them. In some varieties the infection was so severe that almost all of the leaves were killed long before the crop was mature. The difference in the amount of leaf injury in different varieties was so marked that, on June 11, a series of readings was made on the amount of disease. At that time leaves on some varieties had been dead for several days and showed abundant production of the minute black fruniting bodies of the fungus, while other varieties still had many active green leaves. The readings were recorded as estimates on the percentage of the leaves of each variety, killed or severely injured by leaf blotch. The data secured are presented in Table I.

It is realized that these data are inconclusive since they represent only one year's observations. They point out two things very definitely, however, (1) that a severe infection of speckled leaf blotch occurred in Kansas in 1929, and (2) that varieties of wheat differ in their reaction to this disease. It is interesting to note that varieties of hard red winter wheat are in general more susceptible to leaf blotch than soft red winter varieties. The only hard red winter variety to exhibit marked resistance was Fulhard. This variety happens to be a hard-seed selection made from Fulcaster and probably arose through natural crossing between Fulcaster and some hard red winter variety. Kanred, Blackhull, Early Blackhull and Superhard seem to be very susceptible to leaf blotch, while Turkey and Kharkof apparently are moderately susceptible. Tenmarq, Newturk and Oro seemed moderately resistant. Among the soft wheats Harvest Queen, Fulcaster and Michigan Wonder exhibited very little injury on the upper leaves and could easily be located in the plots by their healthy green color. Kawvale seemed the most severely injured of any of the soft wheats, but was by no means so heavily infected as some of the hard red winter varieties.

The hybrid selections exhibited various reactions to leaf blotch, depending on the cross. All of the Prelude x Kanred selections were highly susceptible. Some selections of the Kanred x Hard Federation and Kanred x Marquis crosses apparently were somewhat resistant, while others were susceptible.

No attempt was made to measure the loss in yield caused by leaf blotch, but there can be no doubt that very definite losses occurred. The yields of Kanred, Blackhull and Superhard were low at Manhattan in 1929, although those varieties looked very promising until injured by leaf blotch. In the case of a few of the early hybrid selections the yield was high in spite of a very heavy infection. This probably was due to the earlines of those selections, for the grain was well on the way to maturity before leaf blotch infection became severe. When such standard varieties as Kanred and Blackhull lose 60 to 80 per cent of their leaves two weeks before those leaves should dry up normally, it is only reasonable to suspect that such a condition would be reflected in lower yields.

Black Chaff

Black chaff, caused by Bacterium translucens undulosum EFS, J. & R. is the only bacterial disease of wheat that is of any economic importance in Kansas. Traces of the disease can be found in some localities in the state nearly every year, but it is only in wet seasons such as 1929 that it becomes prevalent. Black chaff was very abundant in the wet seasons of 1915 and 1919 and resulted in considerable damage. It has been reported from time to time as occuring in nearly all of the wheat growing counties from Ellis and Comanche counties eastward. The most severe infections, however, usually have been confined to the more humid eastern third of the state.

The disease is characterized by dark purplish to brown streaks which appear on the glumes and on the peduncles immediately below the heads. When infection becomes very severe the streaks coalesce and the entire peduncle and head may become a solid deep purplish black. In moist weather small droplets of ooze containing the casual organism appear on diseased parts. As the wheat matures the color of affected parts often changes to dark brown. In wet weather, wheat often makes a luxuriant vegetative growth and frequently lodges badly, especially in low, wet spots. It is in these spots that black chaff reaches its greatest development and does the greatest damage. The purplish lesions appear on awns, glumes, peduncles and leaves and quickly discolor nearly all of the green tissues. The grain in the heads of badly diseased plants usually is shrunken and discolored and of very little value.

Although the spring of 1929 was a very wet one, black chaff was not so general in its occurence as in certain other wet seasons. Considerable damage, however, did result from that disease in certain counties of the south central part of the state. The greatest damage was reported from Sumner, Cowley, Butler, Sedgwick, Reno, Harvey, Marion and McPherson counties. In this area considerable damage resulted from black chaff infection in both 1928 and 1929.

One very interesting symptom was brought out by the black chaff infection in southern Kansas in the two years mentioned. Frequent complaints were heard from farmers that the heads of their wheat were all "rat-tailed". Blackhull has been the principal variety grown in that area for some time owing to its high yielding capacity. In 1929 several growers expressed the fear that the variety was "running-out" and pointed to the "rat-tailing" of the heads as evidence supporting their belief. The writer examined many rat-tailed heads and in every case found evidence of black chaff infection. The symptoms consist of a very marked compression of the head with the awns being rather closely appressed. Thus the badly diseased heads are very small and narrow and often speltoid in appearance. Such heads are invariably discolored, very tough, and thresh poorly. If any grain is produced, it is badly shriveled and of inferior quality. Apparently Blackhull is ratehr susceptible to the black-chaff disease and develops the rat-tailed head symptoms in cases of heavy infection.

It should be pointed out that the characteristic black glume color of Blackhull wheat is almost never confused with symptoms of the black chaff disease in the field by one who actually knows this disease. The normal black glume color develops only on normal plants. It appears only shortly before maturity and increases in intensity as the crop matures. Black chaff infection usually prevents the development of the normal black glume color. The purplish black color due to black chaff infection may develop at any time after heading, but usually fades to a dirty brown as the crop matures. The dark color from black chaff infection usually extends to the rachis and the peduncle below the head, while the black color characteristic of the variety is limited to the glumes.

Crinkle Joint

This disease is relatively new to Kansas, having been first reported in the state in 1927. It undoubtedly had been present for some time prior to that season, but not until then had it appeared in sufficient abundance to attract attention. The writer first observed

it in wheat fields in the vicinity of Manhattan early in May, 1927, but was uncertain what caused it and knew of no name for it. Later in the same year a serious outbreak of the trouble occurred in certain experimental plots at the agronomy farm at Manhattan.

The principal reason for the attention given the disease in 1927, however, arose from controversies between hail-insurance companies and farmers as to the cause of the trouble. Some farmers insisted it was the result of hail injury, while the representatives of the insurance companies called it "crinkle joint" and were equally emphatic in their statements that it was due to some plant pathogen or physiologic disturbance. The name crinkle joint was gradually accepted by growers and is now almost universally used by them to specify a particular type of injury.

Crinkle joint, as the disease is designated in Kansas, is characterized by a weakening of the uppermost nodes shortly after heading and a consequent buckling at that point. During rainy weather affected nodes become watersoaked and very weak and the weight of the head causes the stem to bend in the node. As the tissues dry out they may become rigid, but the stem remains bent.

Affected nodes usually become greatly constricted and discolored, with dark brown or black lesions often developing in that region. The constriction may occur before or immediately after the buckling has occurred and often is so severe that the head and peduncle are nearly severed from the remainder of the plant. Usually all of the tillers on a diseased plant are affected, but plants having only one or two affected tillers have been observed.

The diseased plants do not occur in definite spots as in the case of take-all or foot-rot diseases, but are scattered at random throughout the field. Infected plants usually die shortly after heading and are conspicuous among the green plants of normal wheat. A relatively small percentage of bent or broken stems gives a field a very ragged appearance similar to that of a field attacked by Hessian fly. The farmers are familiar with the Hessin-fly injury and know its effect on yield. They therefore realize the losses they are sustaining from crinkle joint and object even to very small amounts of it in their fields. Crinkle joint differs markedly from Hessian fly injury, however, since in the case of crinkle joint, the stems are broken over in the uppermost nodes, while tillers attacked by Hessian fly break over at the crown of the plant. In 1927 and 1928 crinkle joint was found principally in south central Kansas, although traces of the disease were encountered in other sections of the state. Again in 1929, very serious losses resulted in south central counties with heavy infection reported from Sumner, Sedgwick, Harvey, McPherson and Reno counties. Fields were seen in this area in which

10 per cent of the tillers were diseased and broken over, while infections running from 2 to 5 per cent were common. The heads on bent or broken tillers usually are empty or contain only a few small shriveled kernels. It is therefore perfectly obvious that heavy infecticns of crinkle joint are accompanied by a very definite loss in yield.

The cause of this disease is unknown. The roots of diseased plants usually do not show symptoms characteristic of the foot-rot diseases. Furthermore the random distribution of the affected plants is not characteristic of foot-rot. The writer has made many cultures of tissues taken from lesions on constricted nodes of diseased wheat plants. Several fungus organisms have been found to occur in such lesions, but a species of Alternaria has been encountered more frequently than any other. Species of Helminthosporium and Fusarium also have been found, however, and there is no definite evidence that any of these is the causative agent. There is reason to believe that the trouble may be at least partially due to some physiologic disturbance or weakness in the plant, for many plants show no definite evidence of fungous attack.

TABLE I

Reaction of varieties of winter wheat in fortieth acre plots at the Agronomy Farm to leaf blotch (Septoria tritici) Manhattan, Kansas, 1929. Notes taken June 11.

	Upper Leaves			Lower leaves		
	Percentage of leaves killed or severely injured					
Variety	I	II	III	I	II	III
Soft Red Winter						
Kawvale CI 8180	20	20	20	25	35	40
Kanred Ck. Ks. 2401	80	80	80	90	90	90
Harvest Queen Ks. 19	Tr.	Tr.	Tr.	20	25	25
Fulcaster, Ks. 317	Tr.	Tr.	Tr.	10	20	20
Michigan Wonder Ks. 500	Tr.	Tr.	Tr.	5	10	5
Kanred Ck. Ks. 2401	80	80	80	80	90	80
Currell CI 3326	10	5	5	20	30	30
Nebr. No. 28 Ks. 34	5	10	10	20	20	20
Hard Red Winter						
Early Blackhull Ks. 483	60	50	50	80	60	60
Blackhull Ks. 343	60	50	60	80	70	80

Kanred Ck. Ks. 2401	75	60	70	85	80	80
Superhard Ks. 470	75	40	50	80	60	70
Fulhard Ks. 2593	Tr.	Tr.	.Tr.	10	10	10
Kanred x Hard Fed. Ks. 2625	25	40	50	40	60	70
Kanred x Hard Fed. Ks. 2627	60	50	60	80	70	80
Kanred Ck. Ks., 2401	70	60	70	80	80	80
Tenmarq Ks. 439	5	10	10	20	25	25
Tenmarq Sel. Ks. 2637	5	15	10	20	25	20
Newturk Ks. 2536	5	10	10	20	25	25
Oro Ks. 495	15	10	15	25	20	25
Kanred Ck. Ks. 2401	75	60	75	80	80	80
Turkey Ks. 570	25	30	40	40	60	60
Kharkof Ks 382	25	25	30	40	50	60
Kharkof Hays No. 2	10	25	20	20	50	40
Miscellaneous varieties and hybrids						
Prelude x Kanred Ks. 2628	90	80	90	90	90	90
Kanred x Marquis Ks. 2638	25	25	20	50	50	40
Kanred Ck. Ks. 2401	60	70	80	80	80	90
Kanred x Marquis Ks. 2644	30	40	20	60	60	50
Prelude x Kanred Ks. 2652	90			90		
Prelude x Kanred Ks. 2653	90			90		
P1066 x Super Ks. 2654	20			40		
Kanred Ck. Ks. 2401	60			80		
Illini Chief x Kanred Ks. 2656	25			40		
Illini Chief x Kanred Ks. 2655	10			25		
Illini Chief x Kanred Ks. 2657	10			25		
Kanred x Hard Fed. Ks. 2651	10			25		
Kanred Ck. Ks. 2401	70			80		
Kanred x Hard Fed. Ks. 2649	5			25		
Kanred x Hard Fed. Ks. 2648	20			50		
Kanred x Hard Fed. Ks. 2650	5			20		
Kanred x Marquis Ks. 2646	40			60		
Kanred x Marquis Ks. 2647	Tr.			10		
Kanred Ck. Ks. 2401	70			80		
Kanred x Marquis Ks. 2645	25			60		
Kanred x Marquis Ks. 2642	15			40		
Kanred x Marquis Ks. 2640	40			60		
Kanred Ck. Ks. 2401	60			80		
Kanred x Marquis Ks. 2639	20			60		
Kanred x Marquis Ks. 2641	15			20		
Red Hull	50			70		
Cooperatorka	5			10		
Eagle Chief Ks. 408	20			40		

A NEW DEVICE FOR USE IN TEACHING, TESTING AND RESEARCH IN LEARNING

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The psychological laboratories of small colleges are often painfully deficient in equipment and assistants for conducting genuine experimental work for students. This deficiency constitutes an effective barrier to the development of scientific insight and appreciation even among very capable students of introductory courses in psychology. Attempts to obviate this defect by the assignment of experiments to be carried on outside the classroom or laboratory usually result in haphazard juggling of facts and fancies, which tends more to discredit than to clarify scientific method in the student's mind. Probably the most satisfactory solution of this predicament will be found in the development of group experiments conducted in the laboratory or classroom under the immediate direction of the instructor somewhat after the fashion of objective tests.

That genuine, worth-while experiments can be conducted in this manner without the sacrifice of scientific control has been argued convincingly by Terman[1]. It has been the writer's experience that experiments so conducted create a lively interest among students who participate either as assistants or as subjects, and that discussion and appreciation of experimental methods and controls are facilitated by the fund of common experience obtained by students in helping to carry out the experiment and to tabulate and interpret the results.

The most serious inadequacy of the objective-test technique as a means of group experimentation is the length and irregularity of the interval between the subject's reaction and his apprehension of the result. For some types of experiment this defect is of little consequence, but for experimental studies of the acquisition of mental skills as also for other types of learning problem it is all but fatal. It was to remove this defect of the objective-test method by making the results of each reaction immediately perceptible to the subject

1. Terman, Lewis M. The Mental Test as a Psychological Method, Psychological Review, Vol. 31, No. 2, March, 1924.

or examinee that the contrivance here presented was devisd by the writer and Doctor H. J. Peterson of Hattieburg, Mississippi. The device has since proved useful as a means of facilitating the scoring and grading of examinations and in the checking and tabulation of the results of experiments in learning. Hereafter we shall refer to this device as the Self-Instructor and Tester.

Two divergent forms of the Self-Instructor and Tester—a mechanical and a chemical form—have been devised. Both forms are used with lists of questions, problems or excersises of the multiple-choice type. The essential features of the mechanical form may be described briefly as follows:

a. Externally all that is visible is an opaque envelope with rows and columns of small circles printed on the smooth surface as shown at points "a" in Figure 1. Each series (row) of circles represents a definite question or problem in the list of multiple-choice items which accompanies the device and is numbered accordingly. Likewise each circle in a series represents one of several alternative answers or solutions to the particular question or problem represented by that series and is lettered A, B, C, D, etc. accordingly.

b. A hard, tough interior sheet, the selector sheet, fits snugly within the envelope. Directly beneath each circle on the envelope, which represents the correct response to a question there is a perforation in the selector sheet as shown at points "b" in Figure 2. These perforations permit a pin to be thrust through the entire device at any point representing a correct response, but the hardness and toughness of the selector sheet prevents the pin from penetrating the entire device at any other point. To insure perfect registry of perforations in the selector sheet with their corresponding circles on the tester (envelope) surface, those perforations are made slightly larger than the circle on the surface of the tester.

c. Equi-distant spacing of the circles on the tester surface from one-another and from the various margins of the envelope permits each selector sheet to be utilized for four different orders of correct and incorrect responses by merely turning it over, upside down, or over and upside down in the envelope.

d. An intermediate perforated sheet is glued to each side of the selector sheet. Each intermediate perforated sheet has one perforation corresponding in position to each circle on the surface of the envelope as shown at point "c" in Figure 3. These perforations are of the same size as those in the selectoor sheet as shown at points "b" in Figure 2.

With this modified selector sheet sealed snugly within the properly marked envelope it become possible for a student to check immediately the correctness or incorrectness of each choice of alternative responses to a list of problems, questions or exercises expressed

in multiple-choice form without the necessity of consulting his instructor, text or references. This device also gives the instructor or experimenter power to check the accuracy of the subject's responses and his progress in learning by simply counting the pin holes in the tester surface. This can be done most easily by cutting the envelope all around the edge with a sharp knife and holding the record surface up before the light of a lamp or window. To make sure that all the correct responses have been made keep the selector sheet in place behind the record surface until you hold it up to the light. A mere glance will then reveal whether all the correct responses have been punched. Any surplus of perforations beyond one for each question represents erroneous responses. These superflous perforations can be counted with great facility by holding the record surface up alone before the light. With this device an examination comprising a hundred questions can easily be scored in one minute per student of examinee. The relative weight to be assigned to first, second and third errors on a given question can be decided for himself by each instructor.

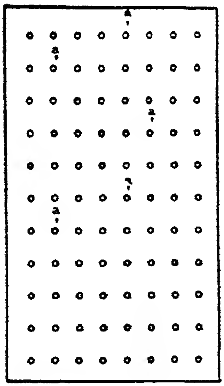

Figure 1.
Tester Surface

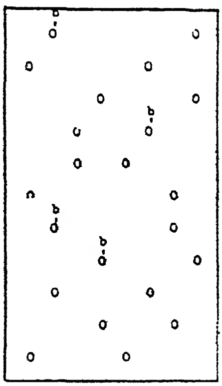

Figure 2.
Selector Sheet

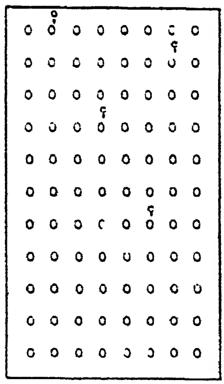

Figure 3.
Intermediate Perforated Sheet

The chemical form of the Self-Instructor and Tester may consist of a single sheet of paper marked in exactly the same manner as the surface of the envelope in the mechanical form (See Figure 1). In this form the portions of the tester surface (circles) representing correct responses are treated with a chemical and the portions representing incorrect responses with another chemical of identical appearance. When brought into contact with a third chemical, these

chemically treated portions change into contrasting colors according to the correctness or incorrectness of the response indicated. This third chemical may be conveyed to the tester surface by a pin, pen, brush or any other suitable instrument. This variety of the chemical form of the tester is used in the same manner as the mechanical form with a list of multiple-choice questions or problems.

Either of the foregoing forms of the tester may be used by any instructor in any subject whatsoever provided he list the alternative answers to his questions so that the correct answers come in the order in which they are indicated on the tester. But it can be used only with students who are sufficiently advanced mentally to find with reasonable ease and accuracy the point on the tester surface corresponding to each alternative answer to a question. This mental requirement corresponds roughly to the average intelligence of pupils in the fourth and fifth grade of the elementary schools.

But the chemical form of the Self-Instructor and Tester can be further simplified so as to make it serviceable for use with any child who can read his questions and choose among simple alternative responses. In this simplified form the alternative answers to each question are printed immediately after the question or often as a portion of the question as illustrated in the following sample questions:

1. Snow is (red — white — blue).
2. Water runs (up — down) hill.
3. Summer is (warmer — colder) than winter.
4. A house fly has (two — four — six) wings.
5. Air (rises — falls) in the center of a cyclone.
6. Dry air feels (cooler — warmer) than it is at 80 degrees F.
7. Humid air feels (cooler — warmer) than it is at 30 degrees F.
8. Rickets can be prevented by the use of vitamin (A- B - C - D).
9. Which of the following drugs reduce the surface tension of water more than that of oil: (O-chloroform O-opium O-caffeine O-strychnine) ?
10. The surface tension of oil is reduced more than that of water by (O-narcotics O-nerve stimulants).
11. Alcohol reduces the surface tension of water (O-less O-more) than that of oil.
12. Alcohol is therefore a nerve (O-stimulant O-depressant).

In the actual chemical form of the Self-Instructor and Tester the correctness of one's choice of responses to questions like those listed

above can be checked by bringing the proper chemical into contact with the line under or the circle preceding the chosen answer to each question. These portions then change to contrasting colors, say red and blue, to indicate correctness or incorrectness of response respectively.

Though simpler and easier for the student to use, this form of the tester is not so readily adaptable to the needs of the individual teacher or experimenter. In this form each new set of questions requires a separate printing of the tester. Moreover the complete printing of this form requires three separate impressions: one for printing the questions and one for each of the two chemicals indicative of correctness or incorrectness of response. This form of the device will find its largest field of application in connection with standard mental and achievement tests and with lists of questions used to direct and check the efforts of students in the study of definite and widely used texts or assignments.

Space will permit only one example of the use of the Self-Instructor and Tester in conducting group experiments which involve some critical and constructive thinking. The disc-transfer problem will serve the purpose very well. Each student is given a set of the following materials and printed instructions:

1. Four small discs of varying size numbered 1, 2, 3, and 4 from smallest to largest in the order of their size.
2. A card containing three circles each slightly larger than the largest disc, arranged in triangular form and lettered A. B and C.
3. A set of directions setting forth the problem and a list of rules for one's guidance in attempting to find the solution.
4. A chemical form of the tester properly adapted for checking the correctness or incorrectness of the subject's responses while finding the solution of the problem.

Directions: Place Discs 4, 3, 2 and 1 on Circle A in the order named with the largest disc at the bottom of the pile, the second largest next and so on to the smallest on top. Your problem is then to transfer these discs to Circle C in accordance with the rules listed below so that they will stand on Circle C in the order of size as before, the largest at the bottom of the pile, the second largest next and so on to the smallest on top.

Rules:

1. Move only one disc at a time.
2. If there are more discs than one on a circle only the top disc may be moved.

3. You may place any disc upon a vacant circle or upon a larger disc.
4. Never place any disc upon a smaller disc than itself.
5. Never move any one disc twice in immediate succession.
6. If possible avoid useless moves.

All possible moves are listed in the Self-Instructor and Tester below. Check each move just before you make it to avoid getting far off the track. To check a prospective move apply chemical number 3 to the line drawn under the position to which you think the disc should be moved. The proposed move is correct if the line turns red but incorrect if it turns blue. As soon as you have checked a move transfer the disc to the correct position and study your discs to discover the next move. Your score will be determined by the number of errors you make—the fewer the errors the better your scor e and vice versa.

The experimenter should here demonstrate the procedure with a set of three large discs and with charts.

SELF-INSTRUCTOR AND TESTER

(Check your prospective moves here)

No. of moves	Place Disc No.	Upon Disc or Circle
1st	1	B or C
2nd	2	B or C
3rd	1	2 or 3
4th	3	B or C
5th	1	3 or 4
6th	2	3 or 4
7th	1	2 or B or C
8th	4	B or C
9th	1	4 or A
10th	2	4 or A
11th	1	2 or 3
12th	3	4 or A
13th	1	4 or B orC
14th	2	3 or B or C
15th	1	2 or A or B

This problem can be extended by having subjects turn over their records and transfer four discs again and again checking their moves each trial on a new tester sheet. Or more discs may be added to make the process as complcated as desired or to study transfer effects from less to more complex problems. From a large timer or from a progressive time record written n the blackboard by a student assistant, subjects may record the time required for the solution of each problem.

Ordinarily this experiment requires that each subject be taken through the work alone—a requirement which draws heavily upon the time of the experimenter. But with the device here described to guide the learner and make a clear, legible and permanent record of each response, there is nothing to prevent large numbers of subjects from going simultaneously through the experiment under the guidance of a single experimenter. Nor should the usual experimental precautions and controls be sacrificed in any degree by this group procedure. Indeed, with proper attentioon to preliminary training and to seating, motivation, etc., the group procedure may well surpass the individual experiment in the standardization and control of those numerous variables which inevitably affect the results of this sort of experiment. Moreover, the results of an experiment are far easier to classify and tabulate from the Self-Instructor and Tester than from an ordinary paper-and-pencil record.

SYMMETRY IN VISUAL MEMORY

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The experiment here outlined was conducted for the purpose of ascertaining the nature of the changes that occur in recall of visually perceived forms. Five simple geometric figures were constructed none of which were symmetrical. The figures were exposed one at a time, each for ten seconds, and twenty seconds after the series was presented the subjects were asked to reproduce the figures. After four days they were told to draw the figures entirely from memory and again at five, eight, nine, twelve and nine day intervals.

In order to tabulate the results it was found necessary to group the changes under various heads, namely, the changes toward symmetry, the cases of no change, the perfectly symmetrical figures and the semi-perfect figures. In addition to this, the individual changes for each figure were recorded along with the chronological drawing in which they occurred. The results show that at the outset the figure had a great many minor changes all of which were toward symmetry and that as time goes on the entire figure becomes symmetrical to the extinction of many of the minor changes. Evidence from further computations substantiate the supposition that if there are only two reproductions separated by a large interval of time, symmetry is more likely to appear than if there are five or six recalls during the same length of time. This means each reproduction of a figure serves to act as a stimulus which will help in the next recall, whereas, if no reproductions are made over the same interval of time, the symmetry tendency is more marked.

The most significant fact that aappeared in this experiment was the characteristically progressive nature of the changes toward symmetry. This means that the pattern functioning in any memory process is one that is dynamic in character and not static; a pattern which changes at a gradual rate and not by a sudden shift. The symmetrical pattern represents the most stable or unified pattern possible. We, therefore, have evidence for the law of pregnancy, namely, that the configuration tends to become as stable or unified as possible. We also know that a unified stable pattern is one which requires a relatively small amount of energy to maintain. This, then, means that the progressive change toward symmetry is a response in the line of least action. That is, the stable, unified, symmetrical pattern represents the low stress or area in an energy system and activity will always proceed in the direction of that low stress; a fact which may account for many of the errors of recall so well illustrated in observations from testimony.

METHODS OF INSTANTANEOUS PHOTOGRAPHY

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That photography occupies an exceedingly important position in every phase of science is an accepted fact. But occasionally it requires some such achievement as the discovery of a trans-Neptunian planet, the track of a Beta-particle or the wave in a proton to emphasize the utilitarian value of this wonderful art.

Employing a multi-speed or ultra-rapid shutter, it is possible to obtain a mechanical exposure in ordinary photography as short as two-thousandths of a second. This interval, however, is much too great for the capture of transient phenomena, such as bullets in flight, falling bodies, sound waves and the electric spark. Consequently, recourse is made to electrical means for operating a shutter on the one hand, or illuminating an object on the other. It is for the purpose of comparing a number of these methods and their applications that this paper is undertaken. The various descriptions will be given in the order in which they were published.

Toepler's Method: Probably the pioneer in the field of instantaneous photography is A. Toepler[1] who in 1867 contrived the "Schlieren Methode". This method was employed most successfully by himself, Mach[2], M. Toepler[3], Wood[4], Mikola[5], Walter[6], Przibram[7], Pedersen[8] and Trey[9] in all of the various transient phenomena mentioned above. The arrangement of apparatus conforming to Toepler's method as modified by Trey, appears in Fig. 1.

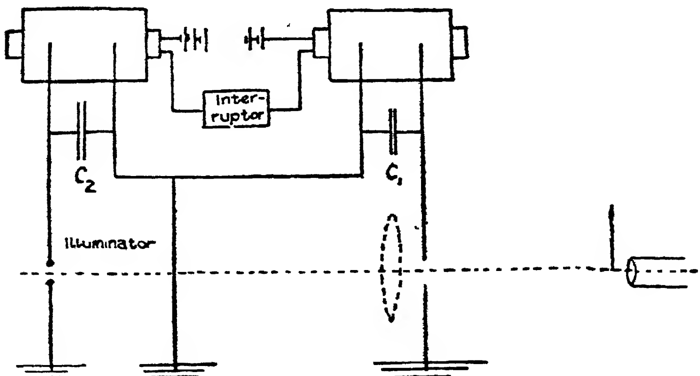


Fig. 1. Toepler's Method.

The figure shows two inductors with their primary coils connected in series with a battery and a common interrupter. By earthing the common connection between the secondary coils of the inductors and by properly adjusting the relative capacities of the condensers connected across these coils, it is possible not only to confine the electrical oscillations resulting from discharges at the object and illuminating gaps to their respective circuits but also to retard the discharge at the latter gap sufficiently to permit its rays to be refracted as they pass through the region of the object gap, thus producing a shadow of the fluid in the latter which may be viewed with a telescope or photographed with a camera. Hence, it is necessary that in order to secure a properly timed spark of a suitable character, there must be available means for storing and releasing such energy at the proper instant. An interesting explanation of the optics involved in this arrangement appears in Edser's[10] book on Light.

Method of Foley and Souder: This method of instantaneous photography, sometimes called the point-source shadow method, was perfected by Professor Foley and Wilmer H. Souder[11] of Indiana University in 1912 during an investigation on sound waves. A sketch of the apparatus as employed by the writer[12] in a study on the electric spark is shown in Fig. 2. According to this method, the electric charge is produced by a large induction machine not shown in the figure. J and T represent, respectively, the capacity and terminals of the static machine. The object and illuminating gaps are connected in series, the retardation being accomplished by a capacity, C, in parallel with the illuminating gap, I. The photographic plate-holder is inserted at P.

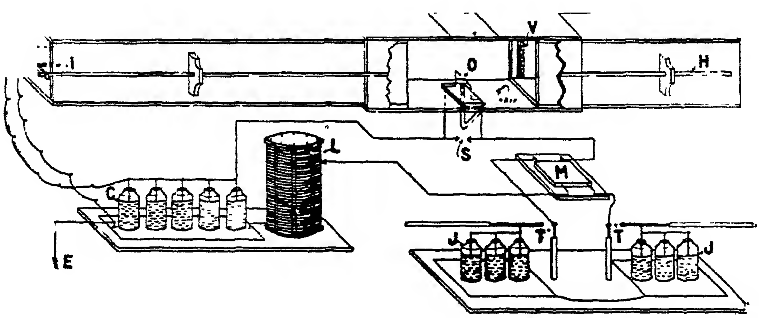
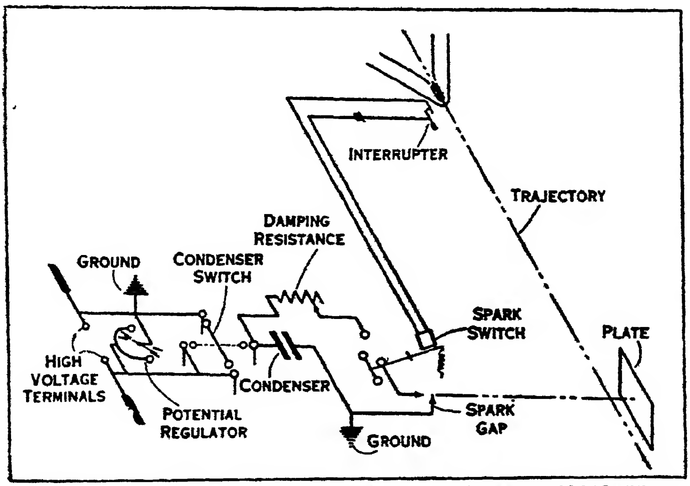


Fig. 2. Method of Foley and Souder

The theory of the method like that of Toepler's is based on the phenomena of diffraction and refraction. Light from a point source is allowed to fall directly upon a photographic dry plate several meters distant from the source. About half-way between the illuminating source and the plate-holder is placed an object consisting of a fluid stream or an electric discharge. The object differing in density from the air about it, causes the light from the point-source to be refracted with the result that a shadow of the refracting object is cast upon the photographic dry plate. The method is so sensitive that it gives a shadow of a stream of water in water. By this method, Professor Foley[11] has procured a remarkable set of sound photographs; he has also applied the method to various other investigations[13]. Others who have used this same method in studies on soap bubbles, rates of explosion of powder, spark discharges and echelon effects on sound are Dutcher[14], Smith[15], Zinszer[12] and Eaton[16].

Method of Miller and Quayle: There is, perhaps, no question in the realm of the ballistics of small arms upon which there has been so great a diversity of opinion as that of the acceleration of a projectile after leaving the muzzle of the gun. It was for this and associated purposes, that during the World War, Professor Miller of Case School was summoned to Washington where he in conjunction with Captain Quayle[17] perfected the following method.



SCHEMATIC WIRING DIAGRAM OF SPARK PHOTOGRAPHY APPARATUS

Fig. 3. Quayle's Method

Having put the film or plate in place, the operator sets the spark switch and starts the generator. The condensers when charged are automatically disconnected from the generator and a signal light is turned on as soon as the potential across them reaches the magnitude at which the regulator is set to function. The gun is then fired immediately. When the sound wave from the bullet or the propelling charge, according to the circumstances, impinges upon the diaphragm of the interrupter, the electric circuit to the spark switch is momentarily opened. The switch arm then closes the so-called trigger gap at such time as the bullet being photographed has arrived in front of the photographic plate. As the trigger gap is closed, the condensers discharge through the trigger gap, spark gap and damping resistance which are all connected in series. If the spark lasts while the bullet moves appreciably blurring will result. Since the spark discharge from a condenser is not of itself of the proper character, the so-called damping resistance is introduced into the spark circuit. In this way a single spark of great brilliance and lasting for only one or two microseconds is obtained. Some idea of the accuracy of the equipment may be obtained from the fact that as many as eighty consecutive shots have been photographed in one lot without a single failure.

Bloxom's Method: Employing an old X-ray machine or an induction coil in conjunction with an electrolytic interrupter and city current, as a source of energy, Bloxom[18] was able to devise a method of instantaneous photography which is rather unique as well as simple.

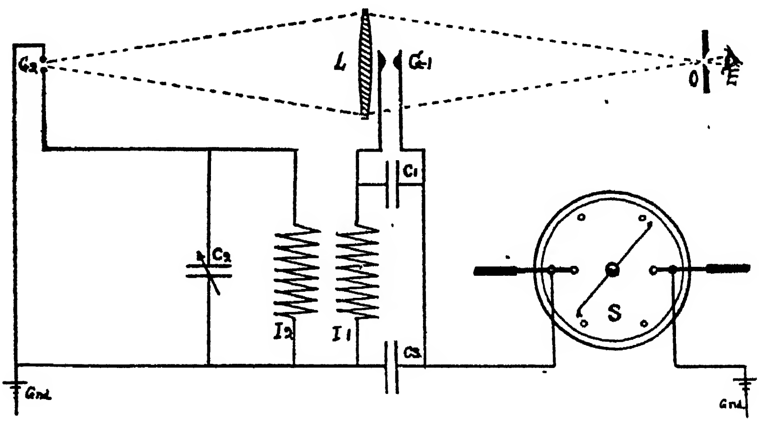


Fig. 4. Bloxom's Method

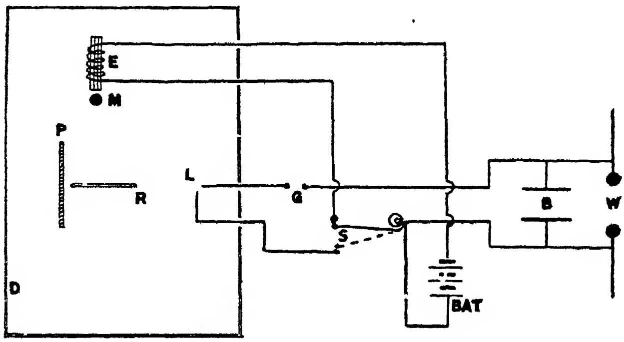
In the figure, L represents a 10 cm lens having a focal length of 50 cm. The distance OL is approximately 100 cm. C_1 and C_3 are

sections of a Murdock Transmitting Condenser, each having a capacity of .0017 mf. C_2 is a variable book-leaf type of condenser improvised from metal sheets and glass plates. I_1 and I_2 are inductively coupled radio coils of the honey-comb type, each having approximately 1500 turns. These coils were imbedded in paraffin to prevent discharging across turns. G_1, the sound gap, is located near the center of the lens and is constructed so that light does not reach the eye from that source. G_2, an adjustable gap located at one of the conjugate foci of the lens, produces the flash that illuminates the wave and field. O is a small aperture in a dark screen located at the other focus. It serves to locate the position for the eye and create contrast between the field and the wave by excluding stray light which is refracted by the areas of distortion caused by the sound wave.

The modus operandi is as follows: C_1 and C_3 become charged simultaneously by the static machine, S. At a certain potential, C_1 discharges across G_1 where a sharp sound wave is generated. C_3 cannot expend much of its energy in this discharge because of the high impedance, I_1, but its charge surges through I_1 to C_1 immediately after, which discharges at I_2 which discharges at G_2. The flash of light emitted at G_2 is thus made to follow the discharge at G_1 by several microseconds and, consequently, catches the wave for the eye while it is still near its source. The retardation of G_2 can be varied by any change that affects the natural period of the combination, which is best accomplished by varying the capacity, C_2. With slight changes images may be obtained on a ground glass at O, and consequently, photographs of the object spark or the sound pulse may be procured.

Method of Woodbridge and Parker: In 1877, Worthington[19] used the light from an electric spark to observe the action of drops of water and other liquids falling on a horizontal plate. In 1891, Lord Rayleigh[20] used this method for examining falling drops and jets of water, also the breaking of soap films. In 1893, Boys[21] employed the direct shadow method for photographing bullets in flight. A modification of Boys' and Quale's methods appears in Fig. 5 which shows an arrangement employed by Woodbridge and Parker[22] for a photographic investigation of falling bodies, for example a steel ball falling through a soap film. The source of electricity was a four-plate Winhurst machine, W, operated by hand. A stationary gap, G, outside the dark-room and in series with the spark-gun, L, regulated the minimum intensity of the spark. The Leyden jar condenser, B, had a capacity of 0.02 mf. The terminals of the spark-gun, L, consisted of aluminum wire 1 mm in diameter and were adjustable for varying the size of the gap. The spark-gun was operated simply by charging the Leyden jars and closing the switch.

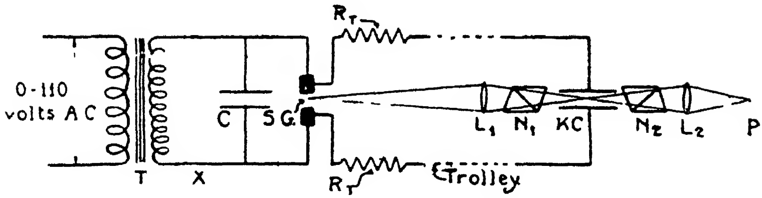
The actual exposure of the plates took place in a separate dark-room compartment, D, large enough for the experimenter to work in. This compartment contained the spark-gun, the photographic plate, P, and the electromagnet, M. The adjustable spring switch, S, served the double purpose of preventing leakage through the spark-gun, L, before the main discharge took place, and also of providing a method of timing the spark to coincide with the passage of the ball in front of the photographic plate. Parenthetically, a photo-electric cell might have served this purpose with greater perfection.



Arrangement of apparatus for photographing falling bodies which must arrive at a definite position when the spark occurs.

Fig. 5. Method of Woodbridge and Parker

Beams' Method: The adaptation by Beams[23] of the electro-optical shutter of Abraham and Lemoine[24] to the studies of the relative time of appearance of spectrum lines in spark discharges has, perhaps, pointed to one of the most successful methods of attack of the problem of the early stages of the spark discharge. In this method, a Kerr cell in conjunction with two crossed Nicols forms the optical shutter which makes it possible to photograph sparks as young as forty billionths of a second. Such an arrangement as applied in their study "On the early stages of the electric spark" by Lawrence and Dunnington[26], appears in Fig. 6. The apparatus consists essentially of a spark gap, SG, with a condenser, C, in parallel, connected across a source of high potential, T, and an electro-optical shutter placed in the optical path between the spark gap and the light recording device at P. The latter is either a spectrograph or a camera. When the spectrograph was used, the source of potential was a one kilowatt transformer. When the camera was used, a high voltage kenotron rectifying tube was inserted at X together with a resistance of about 500,000 ohms.



Experimental arrangement.

Fig. 6. Method of Beams

The Kerr[25] cell consists of parallel plates 9.5 cm long, 1.2 cm wide and 0.5 cm apart immersed in carbon bisulphide. Situated between crossed Nicols, N_1 and N_2, it was attached to the terminals of the spark gap by wires of variable length. This optical shutter is controlled electrically in the following manner: With no voltage on the Kerr cell, the carbon bisulphide is not doubly refracting and hence light cannot pass through the crossed nicols. Upon application of a potential across the cell, the liquid becomes doubly refracting and a fraction of the light is passed, the amount being proportional to the fourth power of the voltage. Since the voltage which is impressed across the gap and condenser is also impressed across the Kerr cell, the shutter opens by the time the voltage is built up to a value sufficient to cause a break-down of the gap. When the gap does break down, the voltage across it drops to a relatively small value in a time interval at least not greater than one-hundredth of a microsecond. A resulting wave is propagated along the wires to the Kerr cell causing a lowering of the voltage across the plates at a time after the spark break-down approximately equal to the length of the wire in one lead from SG to KC divided by the velocity of light. At about the same time that this discharge wave starts from the gap, light from the spark begins to be emitted and travels toward the Kerr cell system. That part of the light which reaches the cell before the wave, is transmitted; while the remainder reaching the shutter thereafter, is rejected. Thus it is possible to observe the spark illumination from its beginning up to any desired time of cut-off determined by the length of the trolley leads.

In view of the apparent revival of interest in the mechanism of the spark discharge and the variation in treatment of the subject, with special reference to Peek[27] and Beams[28], it has seemed worthwhile to the writer to compile the methods appearing herein.

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THE EFFECT OF LIGHT UPON THE FORMATION OF BANDED PRECIPITATES OF MERCURIC IODIDE

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Among the most spectacular of colloidal phenomena are the growth of banded precipitates in gels, commonly spoken of as Liesegang rings. The growth of these bands has long excited interest, and speculation as to their probable mode of formation has often been made. At the present time no satisfactory explanation of their production is commonly accepted.

Very likely the reason for this failure has been due to a lack of consideration, or of knowledge, of all the factors which influence the formation of these bands. We have started the rather ambitious program of an attempt to determine just what variables are involved. Among the possible factors which would influence the growth of these forms are (a) nature and concentration of reactants; (b) nature, history, and concentration of media (gels) in which the reaction takes place; (c) temperature; (d) influence of radiant energy; (e) variation of the viscosity of the intermicellar liquid present in the gel; (f) presence of foreign salts, particularly those formed concomitantly with the precipitate.

This paper deals with the effect of light on the formation of bands of one specific substance, namely mer uric iodide. We are led to report this due to the fact that our observations are somewhat at variance with that of previous investigators as is outlined below.

In a series of experiments to test the effect of light on the production of Liesegang's rings, Tryhorn and Blacktin[1] in 1923, found positive effects in only trhee out of more than thirty tried. These in which most pronounced effects were to be seen were Ag_2CrO_4 and HgI_2. Lead iodide was not quite as brilliant in the dark as in the light but was otherwise unaffected. These investigators placed test tubes side by side in brillant sunlight, in pairs. One of a pair, the same reactants and the same gel, was covered with black paper; the other was exposed to the light. They obtained similar results in both agar and gelatin.

The experiments in which it was found that light had an appreciable effect, were repeated in tubes 30 cm. long, which were painted in bands with Brunswick black. Banding occurred as before where the light fell, but in the dark portions of the tube, they could see no

evidence of precipitation. When the paint was removed a few hours in the sunlight was sufficient to produce bands. They concluded there was no precipitation in the dark, and apparently thought that this was due to adsorption of one of the reactants, according to the theory of Bradford[2]. Moreover they decided that the adsorbed material was released when the light was permitted to act, and that then the reaction went on in the region where no precipiate had previously been formed.

This, however, could not be the true explanation of the phenomenon. For if the gel strongly absorbed the migrating reactant, the rate of diffusion would soon fall through reduced osmotic pressure and the second lighted area would receive only a feeble stream of reactant and the bands would be thin and far apart. In the third lighted area it is probable that no reaction would occur. In reality no such reduction is noticeable when the volume of the external reactant is sufficient.

In the course of some experimental investigations of the precipitation of mercuric iodide in gels of gelatin, agar and silicis acid, it was seen that light had an appreciable effect on the color of the precipitate. The test tubes containing the reacting substances, were placed so they were lighted from the north, and received but very little light from the west and south. In the case of the agar gels it was noticed that while the precipitate on the north side was Red Orange normal (ROn)* for the full width of the band, that on the south side of the tube was ROn for 4mm. The rest was Yellow Green tint 1 (YGt1), a band 8 mm. wide.

Two days later it was seen that the front line of diffusion was advanced to a point 23 mm. from the top. Three distinct bands were to be seen on the north side, the first a 2 mm. band of cloudy gel where the excess of the external reactant had formed the double salt. The second band, 16 mm. wide was of a uniform orange normal color, while the last 5 mm. was green yellow tint 2. Only a few red crystals were visible on that side. On the south side the advance was as great, but with the exception of 4 mm. red orange, the precipitate was of a green yellow color throughout. The two days between observations had been almost without sunshine, rainy and dark with a lowering sky. It was concluded then that sunlight had an effect in converting yellow mercuric iodide to the red, more stable form. When the other test tubes were examined it was noticed that in some gelatin tubes similar effects had been produced.

*Color symbols used in this paper refer to the Color Standard Sheet used in Mulliken's Identification of Pure Organic Compounds, Published by John Wiley & Sons.

To test out this conclusion the agar tubes were removed to the photographic laboratory and placed under two tungsten flood lights, one of 500 and the other of 75 watts. After three hours exposure to this strong light at close range it was seen that a red crystalline precipitate was forming. This was apparently made up of rod shaped crystals of mercuric iodide, closely packed together. In 7 hours it was 1 mm wide. After 58 hours in this intense light the tubes presented the following appearance: At the top, band No. 1 was white and opaque, 3 mm. wide; then 13 mm., orange normal to orange red shade 2; band No. 3 was 6 mm. of GYt2; band No. 4 was formed under continuous strong light, and was 4 mm. wide Orn in color and was composed throughout of needle shaped crystals.

As there was good evidence that light had an effect on precipitation in the case of the iodide of mercury in agar and gelatin, it was thought well to conduct a series of experiments in parallel in silicic acid, since this gel has little protective effect on precipitates as shown by its gold number and it was thought, would give a clearer picture of what occurred then the gels of agar and gelatin, both of which have low gold numbers.

Four gels were prepared from commercial sodium silicate, by diluting to 1.06 sp. gr. and adding dilute acetic acid according to the Holmes' method. In two of these potassium iodide was the external and in two the internal reactant. Mercuric chloride was the other. Two were placed under the flood lights and two in the photographic dark-room. They were examined from time to time and a careful record kept of the progress.

It was found that the rate of diffusion differed but little between the pairs, but the two in which the mercuric chloride was the external reactant, proceeded at a slower rate than in the other pair. After 58 hours this pair showed but little difference in appearance. Both at this time consisted of three bands, the first of which was white in color, and opaque, the gel in this region being filled with double mercuric iodo-chloride. The next band, 15.5 mm. wide, was RON color, and without crystalline appearance in the tube kept in the light, the lower six mm. being somewhat lighter in color, consisting of ORn needles. This lower section had a VR tint, hinting at the separation of iodine.* This became deeper as the gel aged and at seventy hours was a noticeable feature of the gel. The last band in both was Yt2 in color and consisted of close set bristles. One had advanced 25 mm., the other 27 mm., the lighted one having the advantage. These tubes are compared in Table 3.

*Holmes, H. J, Franklin Inst., Dec. 1917, p. 743, had previously called attention to this fact.

The progress of the other two, in which potassium iodide was the external reactant is shown in Tables 1 and 2.

Tryhorn and Blacktin used a very old specimen of agar of the fibrous variety in their experiments. The gelatin used was Nelson's Photographic No. 1. In the case of the agar gel, it is quite probable that the color of the agar would mask any color which might appear, due to the formation of the yellow variety of mercuric iodide. It does not appear necessary therefore to suppose that the diffusing ions are absorbed by the gel so that no precipitate is formed, and that the effect of light is to reverse this process, setting free from these bodies so that reaction may occur. It is more probable to suppose that the formation of mercuric iodide occurs at about the same rate in the dark as in the light; that the metastable yellow form is produced first in accordance with Ostwald's Law of Successive Reactions, that it is transformed but slowly to the red form in the dark[3] but more rapidly in the light, the violet end of the spectrum having the greatest effect[4].

It has been found that the history of the gel-making material has a great effect on the nature of the reaction. Gels of different ages but of the same materials, gels of differing concentrations, gels of varying degrees of impurity, all produce different effects in the precipitates.[5] It has been found by the authors that two test tubes, sitting side by side in the same rack, containing portions of the same batch of gel, with reactants carefully measured into each test tube before the setting of the gel, exhibited many features widely divergent. It is therefore quite possible that the gels that Tryhorn and Blacktin worked with gave results differing widely from those obtained in this laboratory. The authors have found that when the yellow form of mercuric iodide was produced in agar, for example on the dark day, as described in the first part of this paper, it was found impossible to convert this to the red allotrope by exposing the test tube in which it had been formed to sunlight or to flood lights at close range. That formed under the flood lights was produced as the red form. If it was of the yellow form at first, transformation was so rapid that it was not possible to detect the formation of the latter at all. Moreover the red form, produced in this way, exhibited to high degree the rod-forms found in the silicic acid gel when mercuric chloride was the external reactant. These were not found commonly in any other gel and seem to be associated with the very low protective power of the silicic acid. Possibly the light diminished the protective power of the gel material in the case of their ancient agar and permitted them to grow to larger size. In the case of our experiments it appears that once this protective layer was formed it resisted the action of the light, but when the precipitate was in the process of formation, it was possible to prevent the formation of this

layer, so that the first formed bodies were not only permitted to grow to considerable size but the absence of the hydrophilic outer layer favors the formation of the stable form. Moreover it is uncertain whether this result is due to the light or an increase of temperature.

Zsigmondy[6] found that gelatin has the lowest gold number of all the protective colloids that he studied, and silicic acid the highest, having apparently but little protective value. Starch comes very close to the latter in his table; apparently agar lies close to gelatin. These cover the precipitate with a layer which prevents their flocculation and lower their rate of crystallization. On examination with the microscope of portions of the agar gel formed in the dark or in moderate sunshine we could find no evidence of crystals. In gelatin we found that in the yellow portion of the band, the precipitate had no distinct crystalline form to be observed with the microscope but was banded in very narrow rows close together, while in the intervals or clear space which appeared quite empty to the casual glance, minute red crystals were found as tiny rods or united in crinkled threads. No large crystals were to be found.

To test the effect of the short-wave end of the visible spectrum on the precipitate formed in silicic acid when potassium iodide was the external and mercuric chloride was the internal reactant, two test tubes (glass, not quartz) containing this gel were placed under the mercury lamp and exposed at the distance of about 18 inches for about 24 hours. Only the red allotrope was formed during this time but when the light was turned off and the tubes left in the dark, the red form was produced only by the slow transformation of the yellow. After 124 hours in the dark a wide band of the latter was to be seen in advance of the red band.

Summary

Experimental work was carried out in the dark room, under the flood lights, and under the mercury arc to test the effect of light on the nature of the precipitate of mercuric iodide in gels of agar and silicic acid.

It was found that light favored the formation of the red allotrope, while the yellow variety was formed in the dark. The latter form was slowly transformed to the red in the dark, more rapidly in the light, when silicic acid was the reaction medium. When the yellow form was produced in agar, it was not transformed into the red form even by the action of the most intense light. This was thought to be due to the greater protective action of the agar gel.

Because of the protective action of the agar and gelatin gels, the crystals formed in them are minute, except when influenced by light,

when long needles may be formed in the former. Long needles, red or yellow in color, formed lengthwise of the tube tend to be formed in silicic acid, especially when mercuric chloride is the external reactant. The yellow form formed at first is progressively converted to the red form by contact. Banding is distinct, even where the needles seem to be continuous.

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TABLE I.

Reaction in Silicic Acid Gel:

$HgCl_2$, 5 cc., 1N Internal; 5 cc., KI, 4,% External Reactant.

Under Flood Lights 70 hrs.

Time from beginning hrs.	mins.	Band #1 width	Band #1 color	Band #2 width	Band #2 color	Band #3 width	Band #3 color	Condition of Ppt.	Diffusion Front Line
3	40	11 mm	clear	2 mm	Os2	Line	Ot2	Fine Crystals	13 mm
7	40	13 mm	clear	2½mm	ROn	Line	Whitish	in 2nd band	15.5 mm
29	40	23 mm	clear	5 mm	ROn				29 mm
58	40	28 mm	clear	9 mm	Rtl				37 mm
70	40	30 mm	clear	10 mm	ORtl FOn			3 bands Fine Crystals	40 mm
160	40	38 mm	clear	9 mm	OPsl	7 mm	Yt2		53 mm

The lights were turned off at the end of seventy hours and the last 13 mm of diffusion advance was made in the dark. During that time 13 mm. of precipitate was formed, of which 7 mm. was yellow and only 6 mm. was transformed to the red form during that time. In the light no HgI_2 was apparent.

TABLE 2.

Reaction in Silicic Acid Gel:

$HgCl_2$, 5cc., 1N Internal; 5 cc., KI, 4% External Reactant.

In Dark Room 70 hrs.

Time from beginning hrs.	mins.	Band #1 width	Band #1 color	Band #2 width	Band #2 color	Band #3 width	Band #3 color	Condition of Ppt.	Diffusion Front Line
3	40	9 mm	clear	1 mm	On	1.5 mm	Yt1	Crys. in #2	11.5 mm
7	40	13 mm	clear	1 mm	On	2 mm	Yt2		16 mm
30	40	21 mm	clear	4 mm	ROt2	3 mm	Yt1		28 mm
58	40	26 mm	clear	5 mm	ORn	4 mm	Yt2		35 mm
70	40	28 mm	clear	6 mm	ROt1	4 mm	Yt2		38 mm

In the dark the yellow form of HgI_2 is produced and is transformed to the red form slowly. This experiment was started in the light and a thin line of red was visible when it was placed in the dark. Thus the red form was in contact with the unstable yellow form from the beginning and would therefore aid the transformation from the unstable to the stable form.

TABLE 3.

Reaction in Silicic Acid Gel:

KI, 5 cc., 4% Interial; $HgCl_2$, 5 cc., 1N Exernal Reactant.

Under Flood Lights

Time from beginning hrs.	mins	Band #1 width	Band #1 color	Band #2 width	Band #2 color	Band #3 width	Band #3 color	Condition of Ppt.	Diffusion Front Line
3	14	2 mm	clear	5 mm	Osl	Line	On	No vis.crys.	7 mm
7	30	3 mm	clear	8 mm	ROn				11 mm
29	30	5 mm	clear	11 mm	Ron	4mm	YT2	Crowded Bristles	20 mm
58	30	5 mm	clear	a9.5mm b6. mm	ROn) ORn)	6 mm	YT2	2(a)needles) VR between) #3 bristles)	27 mm
70	30	5 mm	clear	a9. mm b7. mm	ORt1) ORn)	7 mm	YT2	#3 YT2 bristles,few RO) #2 Bluish between) fine ORn needles)	28 mm

In all tables Band No. 1 is formed by solution of ppt. in excess of external reactant. Band No. 3 in Table 2 is formed of newly precipitated material. Band No. 2, older precipitate of red form, progressively formed by transformation of yellow variety.

THE DEVELOPMENT OF THE EXTERNAL FORM OF THE GUINEA-PIG (CAVIA COBAYA) BETWEEN 15 DAYS AND 21 DAYS OF GESTATION

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The form of the developing embryo depends upon internal as well as external features. Marked variations occur among embryos of the same copulation age, which may indicate a variation in the time elapsing between copulation and fertilization.

The youngest embryo obtained was 15 days copulation age. The whole blastocyst weighed 0.415 gm. The embryo, measuring 3.2 mm. in length, resembled a 24-hour chick embryo. It had 8 pairs of mesoblastic somites and a pair of segmental plates; the heart was a slightly twisted tube; the neural tube was closed only in the region of the first somites; there was little or no closure of the ventral body wall.

Embryos of 16 days have an average length of 4.4 mm. and an average weight of 0.05 gm. The neural tube has differentiated into the primary vesicles; the somites number 18 to 26 pairs; the ventral body wall has closed leaving the belly stalk as the connection between the embryo and the fetal membranes; the heart-tube has made a complete twist upon itself; 4 branchial arches are present with maxillary and mandibular processes growing ventrally; the body flexures are appearing; the optic cup and lens are forming; the otocyst is open to the exterior.

At 17 days the embryos average 0.056 gm. in weight and 5.49 mm. in length; there is a further increase in development of all structures found in 16-day embryos.

Embryos of 18 days have an average weight of 0.066 gm. and an average length of 6.47 mm; they have 30 to 37 pairs of somites; all body flexures are well formed; the secondary vesicles of the brain are differentiating.

At 19 days the average length of the embryos is 8.26 mm. and the average weight is 0.117 gm.; there are 41 pairs of somites, the final number; the pontine flexure is forming in the brain, the parts of which are now well differentiated; 2 branchial arches are still present; pigmentation of the iris is beginning; the endolymphatic duct is present; the atrial and ventricular portions of the heart are distinguishable; the somites are differentiating into myotome and sclerotome.

At 20 days the embryos, on the average, measure 9.12 mm. in length and weigh 0.139 gm. All structures found in the 19-day embryo have undergone a slightly further development.

A PRELIMINARY REPORT ON THE THERMO- AND ACTINO-ELECTRIC PROPERTIES OF MOLYBDENITE

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Introduction

Considerable work has been done on various mineral substances and chemical compounds within recent years, to ascertain if possible, whether the substance possessed any degree of photo- or thermo-sensitivity; and the characteristics of their responses. Among the most prominent substances which have been tested are selenium, bismuth antimony, hematite, stibnite, and molybdenite. In carrying on such tests the following phases of photo-sensitivity must be considered: (a) The actino-electric effect which designates the e. m. f. generated in a crystal when exposed to a source of light; (b) the thermo-electric, or Seebeck effect which designates the e. m. f. generated when the junction of two substances is heated by thermal conduction or by absorbtion of thermal radiations; (c) the photo-resistant effect which designates the change in resistance that a substance exhibits when subjected to an outside e. m. f. and exposed to light.

It is the purpose of this paper to summarize the phenomena that have occured within samples of molybdenite under the following conditions: (a) The effect of light upon the samples or the actino-electric effect; (b) the effect of light and heat upon the samples or the combined actino- and thermo-electric effects; (c) the effect of heat upon the samples or the thermo-electric effect; (d) the effect of an outside e. m. f. upon the resistance of the samples when in the dark; (e) the effect of light in addition to an outside e. m. f. upon the resistance of the samples or the photo-resistnat effect; (f) the effect of heat, light and an outside e. m. f. upon the resistance of the samples or the combined thermo-electric and photo-resistant effects; (g) the effect of heat only with an outside e. m. f. upon the resistance of the samples.

Historical Data

Koenigsberger and Weiss[1] found the thermo-electric power of molybdenite against iron to be near +750 mv at 23°C. Coblentz[2] found the thermo-electric power of molybdenite against copper to range from +700 to -1,000 mv at 28° to 29°C. The thermo-electric power was considered positive when the current flowed from the hot to the cold junction.

Coblentz[3] explored the actino-electric effect of areas (0.2 mm by 0.2 mm) of molybdenite and discovered that different parts of a sample may show different magnitudes of sensitivity; in fact one spot may show a positive current and another spot a negative current. Furthermore these locations may be as close as 0.5 mm to each other. He also found on dehydrating the samples by baking for several hours and then testing upon cooling that the actino-sensitivity was apparently unaffected. He found that the deflection of a galvanometer may be positive (or negative) depending upon the wave length of the radiations. Lowering the temperature shifts the maximum of the actino-reaction towards the low wave lengths but has no marked effect on the intrinsic value.

Coblentz[4] tested the photo-resistant effect of molybdenite after the samples had been heated for several hours. Raising the temperature to 100°C and testing while hot showed a decreased photo-resistant effect. If the samples were heated to 500°C, cooled and then tested there was no apparent effect, but on heating to a glow the photo-resistant effect was permanently destroyed. At -178°C the resistance of the samples was 150 to 2,000 times as great as it was at room temperature.

Apparatus and Methods

The samples of molybdenite to be tested were mounted on pieces of sheet asbestos (1¾ inches by 2½ inches), being held in place by clips made of spring brass fixed to the asbestos by small stove bolts. Copper leads were then fastened to the clips. The oven was made by wrapping a heating element around a tin box and covering it with a layer of wet asbestos cement. This element was then placed in a larger tin box and the vacant space filled with dry asbestos cement. Leads for electrical connections were insulated from the tin

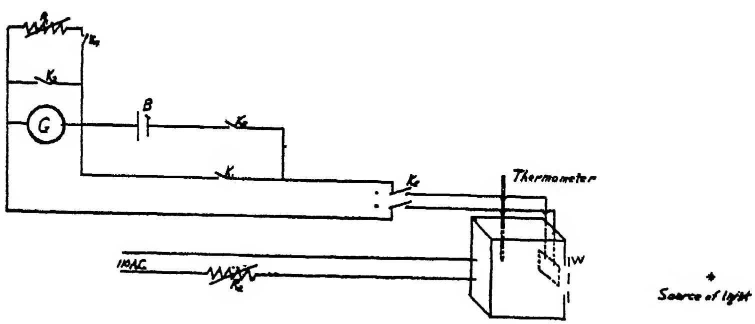

Fig. 1. Sketch of Apparatus

by small glass tubes. The oven door contained a glass window which could be covered when necessary to exclude the light.

The source of light was a 100-watt frosted bulb operating on a 220-volt alternating current. The figure of merit of the galvanometer was found to be 2.56 times 10-10 amperes per millimeter deflection when the scale was one meter distant. Fig 1 shows a sketch of the apparatus.

The order in which the samples were tested is the same order as listed above. When testing the thermo-sensitivity the window was covered to exclude the light. When testing the actino- and thermo-electric effects the battery B was cut from the circuit by opening K_3 and closing K_1. To test the photo-resistant effect K_3 was closed and K_1 open. At times it was necessary to shunt part of the current through the resistance R_1. Then it was necessary to calculate the deflection of the galvanometer by the law of parallel circuits. K_3 is a reversing switch. R_2 was used to regulate the heating current. The source of light was 50 cm distant on all samples with the exception of sample 14 in which case the light was only 10 cm distant. Readings were taken every 25 degrees of temperature between a range of 25° and 300°C. It is the intention of the writer to test the samples at zero temperature and also under the influence of ultra-violet light.

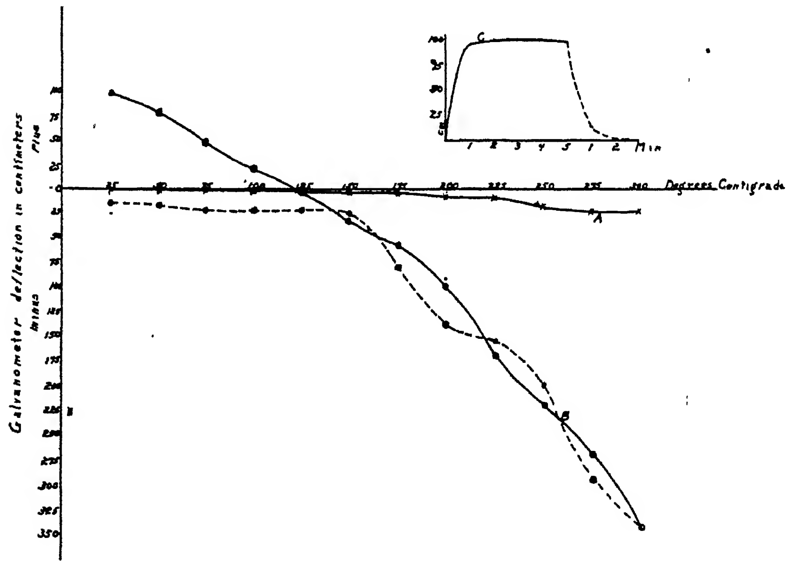

Fig. 2. A=thermo-eléctric effect. B=thermo- plus actino-electric effects. C=actino-electric effect.

Data

Sample No. 13. A series of curves are given in Fig. 2 depicting the actino- and thermo-electric properties of the sample. The actino-electric effect gave a deflection of 100 cm at room temperatures which was approximately 25°C. The combined actino- and thermo-electric effects gave a deflection of -340 cm at 300°C. The thermo-electric effect was negative to the actino-electric effect and ranged between -0.1 cm deflection at 25° to -23 cm at 300°C.

When in the dark and with 0.8 volts in series with the sample the galvanometer showed a deflection of 12 cm. The sample was only slightly photo-resistant at room temperature. Raising the temperature to 300°C caused a large decrease in the resistance of the sample but had no apparent effect on the photo-resistance. Fig. 3 illustrates this reaction.

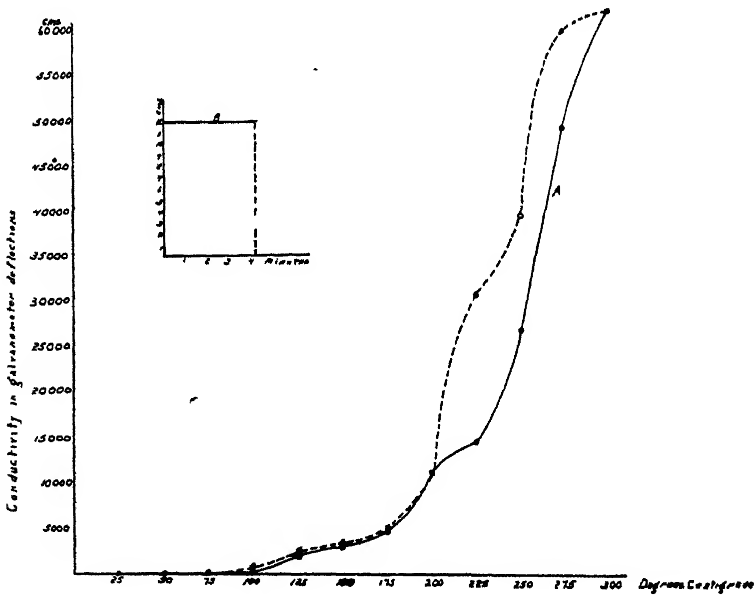

Fig. 3. A=heat, light and e. m. f. effects. B=e. m. f. effect.

Sample No. 14. This sample was not actino-sensitive at room temperature when the light was only 10 cm distant. The combined actino- and thermo-electric effects gave an oscillatory current. The

thermo-electric effect gave a deflection ranging from 0.2 cm at 25° to 16 cm at 300°C. These reactions are shown in Fig. 4.

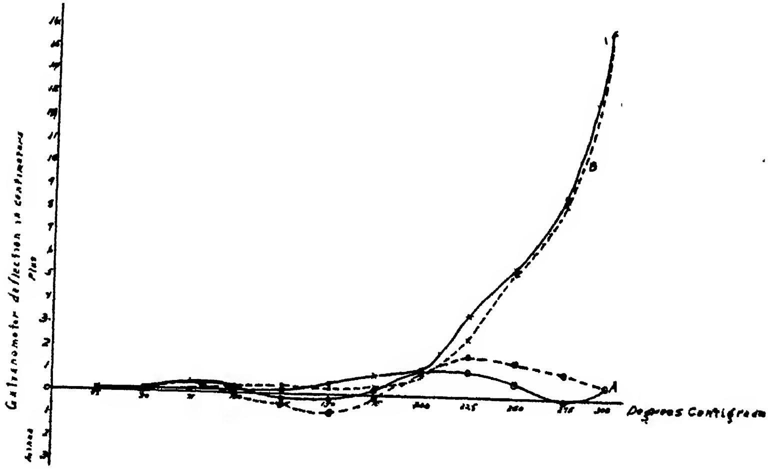

Fig. 4. A=actino- plus thermo-electric effects.
B=thermo-electric effect.

When in the dark and with 0.8 volts in series with the sample, the deflection was 5 cm. The sample was not photo-resistant. The deflection ranged from 5 cm at room temperature to 4,100 cm at 300°C. Evidently heating to a high temperature did not render the sample photo-resistant. Fig. 5 illustrates the effect of heat on the resistance of the sample.

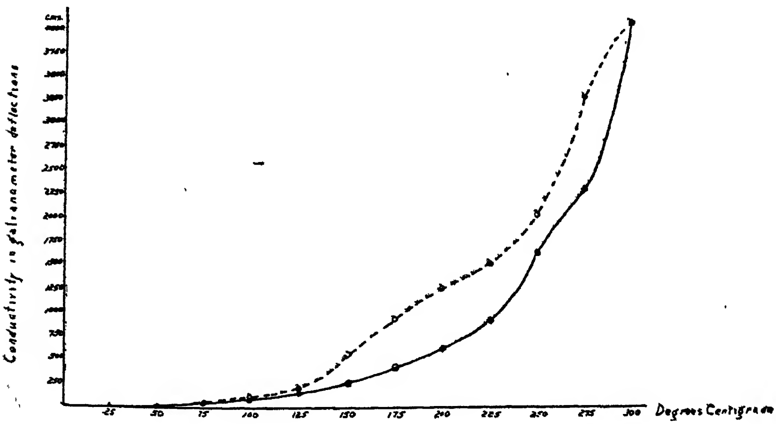

Fig. 5. e. m. f. plus heat effect.

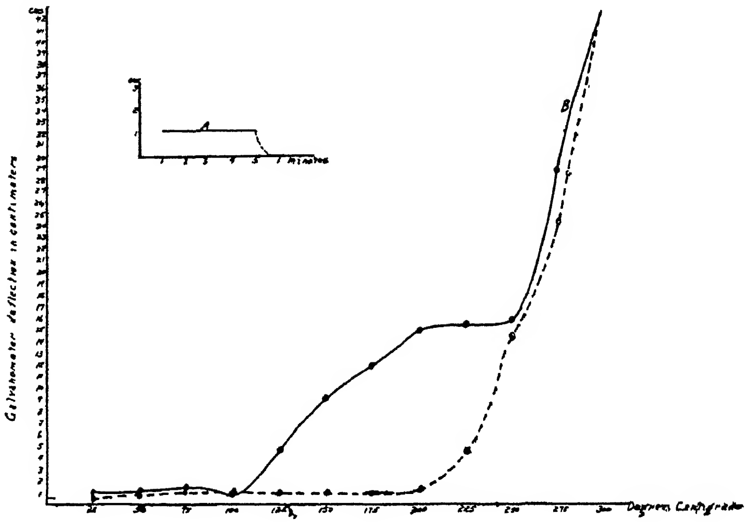

Fig. 6. A=actino-electric effect.
B=actino- plus thermo-electric effects.

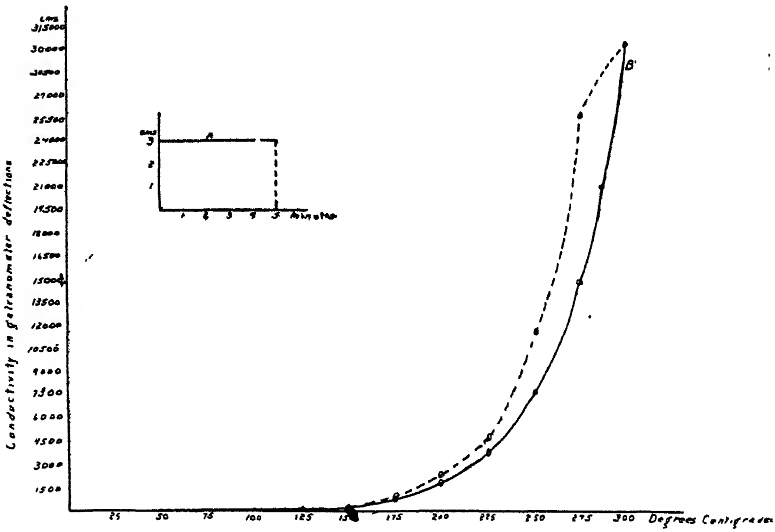

Fig. 7. A=e. m. f. effect. B=e. m. f. plus heat effects.

Sample No. 11. This sample was only slightly actino-sensitive. The combined actino-and thermo-electric effects gave a deflection of 42 cm at 300°C but the thermo-electric effect gave only 29 cm at 300°C. It is possible this difference may be due to fatigue within the sample. The results of this test are graphically shown in Fig. 6.

An impressed e. m. f. of 0.8 volts gave a deflection of 3 cm when the sample was in the dark and at room temperature. The sample was not photo-resistant. Fig. 7 depicts the results of the test.

Summary

From the data at hand it would seem that the actino effect is affected at high temperatures. This was found to be true in samples that were not actino- active at room temperature. The photo-resistant effect apparently was not affected by the application of heat. The resistance of the samples of molybdenite was considerably decreased under the influence of heat.

I wish to take this opportunity to acknowledge my indebtedness to Dr. H. A. Zinszer for his many valuable criticisms and to Dr. W. W. Coblentz of the Bureau of Standards for suggesting the problem and for the samples of molybdenite used.

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THE LAWS OF HUMAN NATURE

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A profound transition is taking place in the science of psychology at the present time. For over a hundred years the basic assumptions of psychology have remained practically unchanged in spite of the fact that the adequacy of these assumptions has been questioned many times. The reason for this lack of progress can be found in an obsolete philosophical heritage from which psychology has been unable to free itself until recent times. Briefly, this heritage is the assumption that physical laws are mechanical and mental laws are non-mechanical. This meant that it was impossible to ascertain the true laws of mind in their relation to body functions. The theoretical difficulties that have stood in the way have disappeared in the evolution of an entirely new set of concepts that fit both the operation of the body and of the mind. These concepts are organismic in character and harbor no mechanistic or vitalistic implications. The assumption is made that the laws of nature are universal laws whether employed by the physicist or the psychologist, and these laws are the laws of dynamics broadly interpreted from an organismic standpoint.

For convenience, eight universal organismic laws can be stated and applied to psychology as follows:

1. The LAW OF FIELD PROPERTIES, which states that the descriptive unit of necessity to be employed in solving any psychological problem is a whole of some sort as comprehensive as the process under investigation. This whole is complex and possesses an organization in its own right that is not derived by additive or synthetic processes from parts or elements that by defintion were not related in the beginning. This law also means that the whole is more than the sum of its parts and posseses properties in its own right.

2. The LAW OR DERIVED PROPERTIES. Any process discovered as a result of analysis owes its properties to a dynamic field of which it is a member. This means that there is no such thing as an element or a part in terms of which the whole can be explained.

3. The LAW OF DETERMINED ACTION. Cause and effect relations obtain only between the whole and its parts, never between one part and another part. In other words, the whole conditions the activities of its parts.

4. The LAW OF INVIDUATION. Parts come into existence through an emergence or individuation process from relatively undifferentiated wholes and as these parts emerge, they are already organized or integated with respect to the whole.

5. WHOLES EVOLVE AS WHOLES. No complex activity is ever the product of additive or synthetic processes but it is an expanding and differentiating pattern of energy whose organization remains intact from beginning to end.

6. The LAW OF LEAST ACTION. This law makes intelligible for the first time in psychology the beginning, the course, direction, and determination of a given event.

7. The LAW OF MAXIMUM WORK describes the expenditure of energy in any system when that system is disequilibrated.

8. The LAW OF CONFIGURATION states that any event is a unit both in space and time and explains why it is impossible to give an account of it in terms of parts or temporal stages. Any event must be explained in terms of conditions external to it no matter how limited or comprehensive the event.

These laws are illustrated in various fields of psychology all the way from social behavior to sensory processes and the functioning of the nervous system. They are laws which have grown out of Gestalt psychology.

ELECTRON-ATOM COLLISION EFFECTS IN MERCURY VAPOR

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In a recent paper[1], the author described an experiment in which he measured the energy losses sustained by slow-speed electrons passing through mercury vapor. It is the purpose of the present paper to review the various phenomena associated with such losses, and to attempt to correlate those which seem to have a common explanation.

In most experiments of this nature, a hot cathode or other source of electrons is surrounded by a grid, by means of which the electrons may be given any desired amount of energy (measured in volts of accelerating potential). During or immediately following this acceleration, the electrons are made to pass through mercury vapor maintained at a pressure varying from 0.001 mm to several mms with different methods. The rest of the experimental setup varies widely with the purpose in view, and may be of either an electrical or an optical nature, or both.

The phenomema observed fall into three classes: those relating to the atom, to the radiations given out by the atom, and to the impinging electron. The atom may exhibit electronegative properties when a valence electron is displaced from its normal position to one more remote from the nucleus, as a result of an impact with an electron; but if one or more valence electrons are entirely ejected from the atom, the latter becomes a positive ion. The potentials at which the rate of production of negative ions receives a sudden increase or decrease were determined by Nielsen[2], and are given in Table I.

The spectroscopic study of the lines emitted by the vapor under varying conditions of excitation has given us a consistant and accurately measured set of energy levels, between which transitions may occur. Eldridge[3] was one of the first to show that the spectral lines do appear when the impacting electron has an energy slightly in excess of that predicted on the basis of these energy levels. The "critical potentials" thus calculated, are tabulated in the second column of the table. The first column gives the data observed by Jarvis[4], using a method developed by Franck and Einsporn[5], known as the photoelectric method. In this case, the radiation from the vapor reacts photo electrically upon a plate, and the resulting current is measured. Other effects are present which are not entirely understood at present, but the data are given as a matter of reference.

The two things which may happen to an electron as a result of an impact are a change of direction and a loss of energy. Brittian[6] has found the critical potentials for scattering of the electrons, which

are given in the last column. The potentials placed in parentheses were not pointed out by him, they being, presumably, too weak to be relied upon. However, they are clearly discernable in his published curves, and are pointed out here because of their good agreement with the data of the first two columns. The energy losses found by the author[7] are given in the third column.

TABLE 1.

Photoelectric Method (Jarvis)	Spectroscopic Levels	Energy Losses (Foard)	Negative Ions (Nielsen)	Scattering (Brittain)
4.53	4.66		4.7	
4.97	4.86	4.9	4.9	4.9
5.22				
5.37	5.43	5.4	5.3	5.7
5.70				
6.05			6.0	
6.46				6.3
6.79	6.67	6.7	6.7	(7.0)
7.13			7.3	
7.74	7.69	7.7		(7.6)
8.02	7.89			(7.9)
8.33	8.58			(8.3)
8.82	8.80	8.8	8.8	(8.9)
9.33	9.2		9.3	
9.58	9.5			9.6
9.90	9.80	9.8		
	10.38			10.3
		11.07	11.4	11.1

At a glance, it is evident that the phenomena here discussed are closely related, as, indeed, one would expect. With very few exceptions, electron scattering and negative ion production are seen to increase abruptly when the speed of the electron is in the vicinity of the critical potential for excitation to a higher energy level. That the agreement is not exact may be accounted for by singularities in the excitation functions, and by factors, as yet unknown, involved in the mechanism of excitation. Lack of selectivity and sensitivity also limit the number of critical potentials observed by the various methods, and, in some cases, may affect their apparent values. However, these data are, on the whole, mutually confirmatory.

A type of impact which the author reported in the paper previously mentioned, , was one involving a loss of energy of 11.07 volts to the electron. The loss was decidedly not one of 10.38 volts, the amount required for the complete ejection of a valence electron, but was about 0.7 volt more than this. Electrons were also found which had made two inelastic impacts, in which the losses of energy were 11.07 and 6.67 volts,—a total of 17.74 volts. At that time, no such energy loss, greater than ionization, had been reported, and some confirmatory evidence was desired. This may be found qualitatively by a study of Table I. If we assume, as seems to be the case, that every loss of energy is accompanied by a deflection of the impinging electron and by the formation of a negative ion, we are led by the results of Nielson and Brittain to expect just such a loss, although spectroscopy has not revealed a corresponding energy level. The author proposed that this loss may be due to the simultaneous displacement of both valence electron in the same atom, without the ejection of either. Sawyer[8] classified four spectral lines of mercury with such a double transition in mind; but a calculation from his work would give an energy loss of 11.35 volts. In view of the accuracy of the values in both experiments, this seems to be an intolerable discrepancy, so that some other hypothesis may be needed to account for one or the other of the values.

Another unexplained effect, first observed by Eldridge[9], was the appearance of a group of electrons which had lost practically all of their energy, presumably in the process of ionization of mercury atoms. Theory would demand that the energy in excess of that required for ionization should be divided between the ionizing electron and the electron ejected from the atom. If either of these electrons is found to have no energy, the other should have all the residual energy; stated analytically, the energy-spectrum curve should be symmetrical about the energy value appropriate to equal energy sharing. Experimentally, the higher speed electrons were not found. Harnwell has found that, in helium[10], the primary electrons lose all their energy, the secondary electrons carrying away the excess energy. In hydrogen[11], he concludes that an electron which makes an inelastic impact is not deflected from its path as much as one which makes a purely elestic impact.

If we can make the bold assumption that these statements hold for a heavy atom like mercury, the anomolous behavior described will become explanable on the following theory of ionization. An electron when it ionizes an atom, loses almost all of its energy, without appreciable deviation, and is discovered by the method used here. The ejected electron acquires the excess energy, but leaves the atom in some direction other than the forward one (or with small probability

in that direction). This electron will have small likelihood of being collected, due to the geometry of the tube here used. It would be of considerable importance to the theory of impacts if an experiment were designed to test this interpretation.

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RECORDING ACTION CURRENTS

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Speculation as to the manner of the functioning of the brain and its accompanying complex structures has a long and controversial history. In recent years the reflex arc concept, as used to explain all human behavior has been shown to be contrary to the facts of such sciences as embryology, neurology and psychology. For instance, Coghill has shown the first movements of embryoes to be total movements rather than reflexes; Lashley, unable to apply reflex concepts to brain functioning, postulates equipotentiality and mass action in the cortex, and many others have shown the inadequacy of the chained-reflex explanations of learning and the consequent stereotyped character of behavior. Clinical evidence in cases of brain lesions is ambiguous. Believing that the time has come for the study of cerebro-dynamics in the laboratory, we propose to see what can be gained by an electrical study of the brain of an intact animal. This paper reports our first results with dogs. We have attempted to test recent speculations such as those of Koehler of electrostatic fields in the cortex and of others closer to actual studies of brain activity.

Since in studies of this kind the technique used is of prime importance, experimentation had to be made to find out a satisfactory means for the production of the least operative shock, the maintenance of the proper temperature and moisture, the construction of firm electrodes, and ones that would neither puncture or unduly depress the cortex, and those which would reach the various areas which we wished to get at, and the selecting of suitable recording devices. At present we have developed or adopted a number of devices or items of procedure which it would be well to enumerate.

Our operating table consisted of a substantial support for the animal made by stretching canvas over a rectangular frame. The animal's legs were dropped through slots in the canvas and allowed to swing free. In this way both comfort and freedom was gained for the animal without the necessity of his gaining a purchase on anything.

Both a general ether and a local anaesthesia were used during operation, the latter from novocain diluted with adrenaline chloride to insure its localization. Before recording, the dog was given time to recover from the anaesthesia. Instead of the usual trephines used for bone operation, we used a rotary saw which made for quicker

work and for surer control of the depth of cutting. With it, almost any shape or size of bone section could be removed. However, we found it advisable to enlarge the original opening by means of special end cutting and side cutting bone nippers. The bone hemhorrage encountered was stopped by plugging the bone with a mixture of beeswax and nujol. Thermocautery was applied to the dura mater where cutting of it was to cross minute blood vessels. Hemhorrage of the brain itself was entirely avoided.

As soon as the operation was completed, irrigation by a constant flow of Ringer's solution at body temperature was set up and maintained at all times except when the electrodes had to be in position for recording. An anchor jack, expanded against opposite edges of the skull with an upright post on it, held the electrode firmly in place against the surface of the brain. The electrodes themselves consisted of a sealing wax matrix of shapes and sizes suitable to the several areas of the brain explored, through which protruded the conducting parts, or points, which in some cases were actual surfaces of a quarter of an inch square. In most cases the electrodes were of the multiple point type, each point being maintained at a constant distance from its neighbors by the matrix whose broad surface also prevented the points from puncturing or materially depressing the cortex beneath them. The points were of either silver or platinum. They were connected to a sliding-contact selective switch which we used to quickly change our recording from area to area while the dog was in one type of activity. By this means some sort of a functional analysis was made without the actual simultaneous recording from a number of areas. So far the most definite results were obtained while using a dead electrode consisting in a silver undersurface attached to a bone clamp which lies directly on the meninges somewhere along the edge of the exposed area of the brain.

Since the electrical phenomona exhibited by the brain are both rather high in frequency and somewhat feeble, the best means of recording has been by the use of vacuum tube amplification and an oscillograph galvanometer. We have used five stages of audio-frequency amplification feeding into a Westinghouse oscillograph. The input was through a transformer to avoid a strictly electrometer effect. At the output the alternating current component only was led through the oscillograph, the plate of the last stage being stabilized with a high resistance. A loud speaker in the series with the resistance was used to listen in now and then to determine readily the open and closed circuit conditions before operating. The direct current component of the fourth stage also passes through a high resistance while the alternating current component is shorted back to the cathode through a condenser across the batteries and resistance.

As an adjunct to the permanent records taken, visible wave patterns were possible by the use of a small model of Metfessel's device which is a wheel bearing series of white cardboard blades spreading out the transverse excursion of the moving point of light. All of the permanent records were made on standard size super-speed motion picture film with an electrically driven camera kept at constant speed by means of a centrifugal governor. The speed used throughout this study was twenty-one inches per second.

With the apparatus described we have succeeded in recording action currents from at least three distinct parts of the brain, ectolateral, posterior lateral and lingual gyri in the occipital lobe, the middle ectosylvian and suprasylvian and the adjacent postcruciate gyri on the boundary of the temporal and parietal lobes, and from the sigmoid gyri in the frontal lobes. These action currents appear to be of the same general nature as those obtained from peripheral nerves showing both single and isolated impulses sometimes following each other at regular intervals of 25 to 250 sigma, and again trains of impulses at constant frequencies. There would appear to be no very essential difference between different parts of the cortex in the form or frequency of the impulses themselves. At any one point one may obtain a wide variety of temporal and intensity relationships.

The problem which has been of perhaps foremost interest is the general question of specialization of function. Older notions of localization of function due to anatomical determination have been almost completely overthrown in recent years. We are attempting in its place to construct some view of the functional specialization which may be in existence at any one moment.

The fact that rather simple patterns are obtained by the use of electrodes making contact with relatively large areas indicates that a high degree of specialization is not the case. The elecrtodes used averaged about one-sixth of an inch in length and varied from one-hundredth to one-sixteenth square inches. It may be safely said that we obtained simple patterns from areas equal to one four-hundredth of the total brain surface. It may readily be seen that this is not at all sufficient for spatial reference for nearly all the discriminable functions that the psychologist knows. We must fall back upon temporal factors within these areas, qualitative factors within these areas, or functional patterns involving perhaps large portions of the cortex. In fact we appear to be able to get at least similar results from areas several times the above size with strenous movements of the dog making even such specialization as I shall indicate below doubtful.

Evidence, on the other hand, is readily available showing that there is a degree of specialization. We have not been able as yet to exactly determine the limit of this due to our inability to con-

trol the type of impulses which we were obtaining. In general, too, we get records from the so-called motor and somaesthetic areas with active movements of the dog, from the somaesthetic and not from the motor in passive movements, and slight effects in the visual area with a change from light to dark in the room. In certain cases we obtained records from the so-called visual areas during active movements of the dog. This may indicate that these so-called sensory areas were in this case an integral part of the dynamic pattern which gave rise to the movements. Similar facts might be adduced in the case of the so-called somaesthetic areas.

It would appear, however, that there must be a spatial factor in the dynamic pattern in order to give a sufficiently differentiated reaction here to correspond with our experiential data. The limited complexity of the records which we obtained makes it impossible to account for all of the differences in the reactions of the animal in terms of the type of pattern of the records. This fact coupled with the size of the electrode leads one to infer that a particular part of the brain does not play the same role at all times but that its function is determined by the relations which it bears to other parts of the brain. Specialization of function, that is, the existence of a spatial element in the functioning of the cortex, is a fact, but we do not know the degree to which this specialization is true, nor its constancy over a period of time.

One other set of facts seems to stand out. It appears to be very difficult to get records from the cortex except when the animal is actively participating in the situation as presented. Also, disturbances were frequently noted upon the initial use of a particular stimulus while it was impossible to get them after a few repetitions. The strength and number of the stimuli were such as to make it unlikely that sensory adaptation had taken place. The effect was more nearly analogous to the lack of attention to a meaningless object after it had been experienced a few times. These facts have led us to set up the supposition that the cortex functions significantly, that is, differentially, only in those activities of the animal which represent his most complete integration, we mean by these, such activities as are represented by perceptual experience in man. This means, if proven, that sensory activities do not have to have a representation in the cortex such as a cortical retina in the case of vision, except as they are represented as the differential portions of a particular experience. When the experience of the dog is dominated by some other factors than those which are controlled by the experimenter, one cannot expect to get a correlation between his conditions and cortical activities. On the other hand, a comparatively slight shift in the conditions may later give one records from what appears to be the same situation.

Further work is in progress along all of the lines suggested.

ADDITIONS TO "THE FUNGOUS FLORA OF KANSAS"

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The following named species, with their field numbers, have been added to our list since the original publication by the Kansas State Agricultural College in a bulletin entitled "The Fungous Flora of Kansas" in the autumn of 1927. Of the species herewith given all were collected by the author, in various parts of the state, with the exception of the three unnumbered species which were reported by Miss Ethel Feese of Junction City. The field collection numbers follow the names of the several species.

List

Ascochyta Treleasei Sacc. & Vogl. .... (10769)
Botrytis aureofulva Barth. n. sp. .... (10562)
Claudopus nidulans (Pers.) Peck x
Clitocybe compressipes Peck .... (9976)
Clitopilus prunulus Scop. x
Colletotrichum gloeosporioides (Penz.) Sacc. .... (10476)
Coniophora umbrina (A. & S.) Fr. .... (10560)
Corticum radiosum Fr. .... (10322)
Cucurbitaria juglandina Ell. & Barth. (not "C Juglandis" as in the Fungous Flora p. 13 .... (2939)
Cytospora Gleditschiae Barth. n. sp. .... (10645)
Cytospora Ricini Dearn. & Barth. n. sp. .... (10823)
Cytospora Thujae Sacc. & Ell. .... (10735)
Cytosporella Populi Oud. .... (10909)
Cytosporina viticola Barth. n. sp. .... (10899)
Diatrypella Populi Ell. & Holw. .... (10350)
Dichomera Acaciae Dearn. & Barth. n. sp. .... (10908)
Diplodia acericola Barth. n. sp. .... (10902)
Diplodia Aesculi Lev. .... (10330)
Diplodia Ulmi Dearn. .... (10842)
Dothiorella acericola Barth. n. sp. .... (10903)
Eutypella scoparia (Schw.) E. & E. .... (10843)
Gloeosporium rosaecola Dearn & Barth. n. sp. .... (10343)
Haplosporella Elaeagni Barth. n. sp. .... (10654)
Haplosporella Tamaricis Barth. n. sp. .... (10624)
Helminthosporium fusiforme Cda. .... (10552)
Hormiscium stilbosporum (Cda.) Sacc. .... (10564)
Inocybe intricata Peck .... (9977)
Isaria felina (DC.) Fr. .... (10348)
Lepiota miamensis Morg. .... (9978)

Licea variabilis Schrad.	(10881)
Lycoperdon marginatum Vitt.	(9939)
Lycoperdon rimulatum Peck	(9938)
Peniophora arachnoidea Burt	(10195)
Phoma negundinicola ramicola E. & E.	(9829)
Polyporus robinophilus (Murr.) Overh.	(10141)
Puccinia punctiformis Diet. & Holw.	(10716)
Radulum laetum Fr. (?)	(10346)
Septogloeum Ampelopsidis (E. & E.)	(10354)
Septonema toruloideum C. & E.	(10561)
Septoria argyraea Sacc.	(10655)
Septoria Fairmani E. & E.	(10331)
Sphaeropsis Cedrelae Barth. n. sp.	(10279)
Sphaeropsis Thujae Barth.. n. sp.	(10734)
Sporodesmium Maclurae Thum.	(10794)
Stereum erumpens Burt	(10469)
Stereum Murrayi (B. & C.) Burt	(10283)
Stereum pubescens Burt	(10283)
Stereum umbrium B. & C.	(10430)
Trametes heteromorphus Fr.	(10175)
Tremella lutescens Pers.	(10580)
Trogia crispa (Pers.) Fr.	(9979)
Tubercularia cava Cda.	(10876)
Tubercularia Celastri Schw.	(2514)
Tubercularia nigricans (Bull.) Link	(8676)
Tubercularia purpureonigra Barth. n. sp.	(10894)
Tubercularia Sambuci Cda.	(10033)
Tubercularia sarmentorum Fr.	(10877)
Volvaria volvacea Bull.	x

THE STRIATED SPARK

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In 1867 Toepler[1] found the existence of a pulse spreading from the region around the spark immediately after it had passed. Since the density of the air in the pulse differs from that of the surrounding gas, the pulse is optically different from the rest of the field and so can be made visible by the "Shadowgraph Method". Toepler's work was the first of its kind where an instantaneous view, say of the order of several millionths of a second, of the electric spark was obtained. In 1926 Dr. Zinszer[2], while studying the life history of the electric spark by the shadowgraph method, found that in some of the discharges under consideration the gap between the electrodes was filled with alternate light and dark laminae or striations of about a millimeter in width. In a paper by Dr. Zinszer[3], on the "Mechanism of a Condensed Spark Discharge" he discusses briefly the striations produced in some types of discharges. He considers that they might be laminal aggregations of supercharged particles which are urged away from or attracted to oppositely charged terminals without an appreciable interchange of charge. There is another theory which might be considered, and that is that the striations may be analogous to standing waves in a Kuntz tube, the gap between electrodes producing the necessary resonance column and the spark concussion producing the necessary energy.

The object of this investigation was to discover whether striations could be produced at will, and if so to determine what factors controlled them. The apparatus, with slight variations was essentially the same as that used by Professor Foley and W. H. Souder[4] in their work on "A New Method of Photographing Sound Waves", and the same as that used by Dr. Zinszer[2] in 1926.

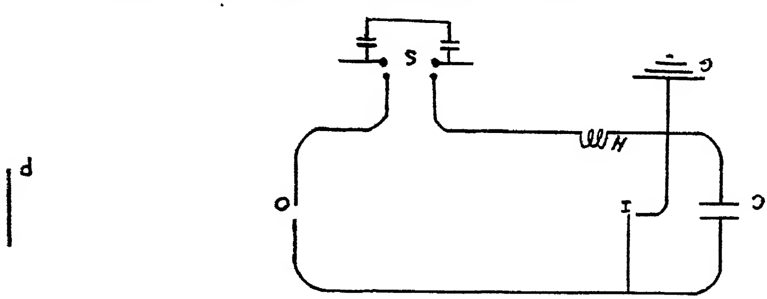

Fig. 1. Diagram of Camera. C. retarding capacity. I. illuminating gap. G. ground. H. choke coil. O. Object gap. P. dry plate. S. static machine.

The first objective was to produce striations in an ordinary spark gap in open air. This was found possible when using approximately 53,000 volts from the static machine, a retarding capacity of about .004 mf across the illuminating gap, and an inductance of about 160 micro-henries in series with the same which was 3 cm between electrodes. These electrodes were of No. 24 magnesium wire placed in an open glass tube 8 mm in diameter, thus giving a gun effect. The object gap distance was 1.5 cm between electrodes upon which were mounted hard rubber buttons 1.3 cm in diameter. At each setting of the circuit it was necessary to take several pictures, as there were fluctuations in the discharges which could not be controlled. However, these variations were nothing like those due to an alteration in the circuit.

The second procedure was to determine the relation between quantity of discharge and striations. This was accomplished, first, by varying the voltage output from the static machine; and second, by placing an auxiliary gap in parallel with the object gap.

The next step was to determine the relation between age of spark and striations. By varying the retarding capacity from a few micro micro-farads up to eight thousand it was not only possible to procure pictures very early in the development of the spark but also so late that the hot gasses could be clearly seen as a cloud-like form filling the gap and extending several centimeters into the space beyond.

The next thing tried was to observe the effect upon the striations of varying the distance of the object electrodes, the rest of the circuit remaining constant. This was accomplished by the use of a micrometer screw arrangement, the distance being extended from 1.5 cm to 2.2 cm and pictures being taken at each millimeter of variation.

Finally, it was desirable to determine the effect of pressure and vacuum on the striations. This was by far the more difficult task, as it required the construction of a chamber around the object gap capable of standing pressure and vacuum; it also had to be transparent and free from irregularities of refraction. Nine different types of chambers were tried, but none of them were exactly satisfactory in all respects.

Summarizing it may be concluded that:

1. Striations are not produced in weak sparks but require a heavy condensed discharge.

2. Striations occur late in the development of the spark or rather after the spark has passed, but before the hot gasses have time to diffuse between the electrodes into an irregular shape.

3. The variation of the gap distance from 1.5 cm to 2.2 cm did not seem to make any difference; that is striations were produced throughout the range.

4. The results from vacuum and pressure variations were not found reliable.

5. All striations appeared to be of an equal length and of an equal width.

In conclusion I wish to thank Dr. H. A. Zinszer for proposing the subject, and for his interest and many helpful suggestions.

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THE FLORA OF CLAY COUNTY, KANSAS

CLEMENT WEBER
Clay Center, Kansas

Clay County is located northeast among the central counties of the state of Kansas, comprising an area of 660 square miles, being divided diagonally by the Republican river. The Republican valley is about a mile in width with sandy fertile soil. To the northeast the land is rolling with a large number of good cultivated diversified farms. Land lying to the southwest of the valley consists of rolling farm-land breaking to rough blue stem pasture land with the exception of Chapman creek. Limestone is found in the southern and eastern parts of the county and red sandstone in the west and northern portion.

Interesting, indeed, and fascinating it should be to take a glimpse at the early events and fruitful development of our own county. When Coronado visited this section in 1542 it was known as the "American Desert" occupied by the warlike Pawnee Indian tribe who held undoubted sway over all the land between the Platte and Arkansas rivers. Their power dwindled, however, and before 1825 they were replaced by the Kaw tribe leaving only a remnant of the powerful Pawnees in the Indian territory. When the first settlers came to Clay county in 1856 they found it, of course, in possession of the Kaw tribe.

The territorial legislature in January 1860 defined the boundaries of the county and named it after the matchless statesman, Henry Clay of Kentucky. It did not function fully as a county until the year 1866, being attached at different times to Riley and Davis counties. The organization of Clay county, as we know it today, dates back to 1866. At first it had but three townships; Sherman on the north, Republican on the south, with Clay Center occupying the middle part. In the course of time these townships were divided and subdivided again, up to the year 1880, into eighteen townships of our own day.

The first settlers had an impression that the uplands were valueless for farming purposes and so we find them taking their homesteads and building their homes along the course of the Republican river and by the creeks in which our county abounds. This illusion was shattered by the arrival of the English home-seekers in 1870, who occupied the prairies between Chapman creek and the river, and we recognize it today as one of the fair and fertile spots of our county.

The rapid growth and development of Clay County was marvelous, and though all the dreams of the early pioneers may not be realized, they laid the foundation deep and strong of the prosperity that is ours in this generation. "All honor to the fearless men and women of pioneer days."

Today Clay County can vie with any county in the state in its agricultural output of wheat, corn and alfalfa, with its pasture lands unsurpassed and its orchards and vineyards that smile in their plenty.

The wild flowers bloomed in our valleys and hillsides in those early days with more or less profusion as they do today, they smiled from their little homes in the prairies to brighten the lives of our forebears as they smile today. It has been the delight of my vacant hours to make a collection of the wild plants of our county and though conscious that this list may not be entirely complete, yet it yields a generous contribution to the flora of the Sunflower State.

This collection of 600 plants to the greater extent has been deposited with the Kansas State Agricultural College and I am much indebted to Dr. F. C. Gates, professor at the Agricultural College, Manhattan, Kansas, for aid in identifying the specimens. A list of plants of Clay County that was compiled by A. S. Hitchcock, previous to 1900, contains 216 species. Most of these, with a few exceptions, were found by the author of the present list, although the nomenclature does not always agree. In grouping and naming the plants which appear on the following list, the second edition of "Britton & Brown's Illustrated Flora of the Northern States and Canada" was followed, except where the names were supplied from different sources by Dr. Gates.

THE FLORA OF CLAY COUNTY, KANSAS

Polypodiaceae—Fern Family

Woodsia obtusa ------------------Blunt-lobed Woodsia
Frequently found on rocks.
Pellaea atropurpurea --------------Purple-stemmed Cliff-brake
Found on rocks in the extreme northern part of the county.

Marsileaceae—Marsilea Family

Marsilea vestita ------------------Hairy Pepperwort

Equisetaceae—Horsetail Family

Equisetum arvense ----------------Field Horsetail
Equisetum praealtum -- Scouring Rush
Found in wet places and along banks.
Equisetum kansanum -------------Scouring Rush
Frequently found in wet meadows.

Pinaceae—Pine Family

Juniperus virginiana ---------------Red Cedar

Typhaceae—Cattail Family

Typha latifolia --------------------Broad-leaved Cattail

Zannichelliaceae—Pondweed Family

Potamogeton foliosus --------------Leafy Pondweed
Potamogeton pusillus --------------Small Pondweed
Zannichellia palustris --------------Horned Pondweed

Alismaceae—Water Plantain Family

Sagittaria latifolia -----------------Broad-leaved Arrowhead

Poaceae—Grass Family

Tripsacum dactyloides --------------Gama Grass
Andropogon scoparius -------------Little Bluestem
Andropogon furcatus ---------------Big Bluestem
Sorghastrum nutans ---------------Indian Grass
Holcus sudanensis -----------------Sudan Grass
Syntherisma sanguinale ------------Large Crab Grass
Leptoloma cognatum ---------------Diffuse Crab Grass
Paspalum stramineum -------------Straw Colored Paspalum
Echinochloa crus-galli -------------Barnyard Grass
Echinochloa walteri ----------------Salt Marsh Cockspur Grass
Panicum dichotomiflorum ----------Spreading Witch Grass
Panicum capillare -------------------Witch Grass, Tickle Grass
Panicum virgatum -----------------Switch Grass
Panicum huachucae ----------------Hairy Panic Grass
Panicum tennesseense -------------Tennessee Panic Grass
Frequently found in moist ground and along marshes.
Panicum scribnerianum ------------Scribner's Panic Grass
Panicum oligosanthes --------------Few-Flowered Panic Grass
Chaetochloa verticillata ------------Bristly Foxtail Grass
Chaetochloa lutescens --------------Yellow Foxtail
Chaetochloa viridis ----------------Green Foxtail Grass
Chaetochloa italica -----------------Italian or German Millet
Cenchrus pauciflorus --------------Sandbur
Homalocenchrus virginicus ---------White Grass
Homalocenchrus oryzoides ----------Rice Cut Grass
Stipa spartea ----------------------Porcupine Grass
Aristida basiramea -----------------Forked Triple-awned Grass
Aristida oligantha -----------------Few-flowered Aristida
Muhlenbergia schreberi ------------Dropseed Grass, Nimble Will
Muhlenbergia mexicana ------------Satin Grass
Muhlenbergia racemosa ------------Wild Timothy, Satin Grass
Phleum pratense -------------------Timothy
Alopecurus geniculatus ------------Marsh Foxtail
Sporobolus neglectus --------------Small Rush Grass

Sporobolus asper ----------------Long Leaved Rush Grass
Sporobolus cryptandus ------------Sand Dropseed
Cinna arundinacea ---------------Wood Reed Grass
Agrostis palustris ---------------Redtop
Agrostis hyemalis ---------------Rough Hair Grass, Flyaway Grass
Calamovilfa longifolia ------------Long Leaved Reed Grass
Capriola dactylon ---------------Bermuda Grass
Spartina michauxiana ------------Tall Marsh Grass
Chloris verticillata --------------Windmill Grass
Schedonnardus paniculatus --------Texas Crab Grass
Bouteloua hirsuta -----------------Hairy Mesquite Grass, Grama Grass
Bouteloua oligostachya ------------Mesquite Grass, Grama Grass
Atheropogon curtipendulus --------Tall Grama Grass
Eleusine indica ------------------Wire Grass
Bulbilis dactyloides ---------------Buffalo Grass
Tridens flava ---------------------Tall Redtop
Diplachne acuminata --------------Sharp Scaled Diplachne
Eragrostis cilianensis -------------Love Grass
Eragrostis pectinacea -------------Purple Love Grass
Eragrostis trichodes --------------Hairlike Love Grass
Eragrostis hypnoides -------------Smooth Creeping Love Grass
Sphenopholis obtusata ------------Early Bunch Grass
Koeleria cristata -----------------Koeler's Grass
Korycarpus arundinaceus ---------American Korycarpus
Distichlis spicata ----------------Alkali Grass
Dactylis glomerata ---------------Orchard Grass
Poa pratensis --------------------Kentucky Bluegrass
Festuca octoflora -----------------Fescue Grass
Bromus tectorum -----------------Downy Brome Grass
Bromus inermis ------------------Hungarian Brome Grass
Often found along roadsides, escaped from pastures.
Bromus arvensis -----------------Field Brome
Lolium multiflorum ---------------Awned Rye Grass
Occasionally found in lawns and waste places.
Agropyron smithii ----------------Western Wheat Grass
Hordeum pusillum ----------------Little Barley
Hordeum jubatum -----------------Squirreltail Grass
Elymus virginicus ----------------Virginia Wild Rye
Elymus canadensis ---------------Nodding Wild Rye

Cyperaceae—Sedge Family

Cyperus inflexus -------------------Awned Cyperus
Cyperus schweinitzii ---------------Schweinitz's Cyperus
Cyperus bushii --------------------Bush's Cyperus
Cyperus esculentus ----------------Yellow Nut Grass

Cyperus strigosus ------------------Straw Colored Cyperus
Eleocharis olivacea ----------------Bright Green Spike Rush
Eleocharis ovata ------------------Ovoid Spike Rush
Eleocharis obtusa ------------------Blunt Spike Rush
Eleocharis engelmanni -------------Engelmann's Spike Rush
Eleocharis palustris ---------------Creeping Spikerush
Eleocharis acicularis ---------------Needle Spikerush
Eleocharis acuminata --------------Flat Stemmed Spikerush
Fimbristylis puberula --------------Hairy Fimbristylis
Scirpus hallii ----------------------Hall's Clubrush
Scirpus americanus ----------------Chairmakers Rush
Scirpus validus --------------------American Great Bulrush
Scirpus atrovirens -----------------Dark Green Bulrush
Scirpus lineatus -------------------Reddish Bulrush
Hemicarpha micrantha -------------Common Hemicarpha
Carex gravida ---------------------Heavy Sedge
Carex vulpinoidea ------------------Fox Sedge
Carex scoparia --------------------Pointed Broom Sedge
Carex tribuloides ------------------Blunt Broom Sedge
Carex festucacea -------------------Fescue Sedge
Carex varia ----------------------- Emmon's Sedge
Carex meadii ----------------------Mead's Sedge
Carex grisea ----------------------Gray Sedge
Carex bushii ----------------------Bush's Sedge
Carex lanuginosa -------------------Woolly Sedge
Carex hystricina -------------------Porcupine Sedge

Araceae—Arum Family

Acorus calamus --------------------Sweet Flag

Lemnaceae—Duckweed Family

Lemna minor -----------------------Lesser Duckweed

Commelinaceae—Spiderwort Family

Commelina communis ---------------Asiatic Dayflower
Tradescantia brevicaulis -----------Short Stemmed Spiderwort
Tradescantia bracteata ------------Long Bracted Spiderwort
Tradescantia occidentalis -----------Western Spiderwort
Tradescantia reflexa ---------------Reflexed Spiderwort

Juncaceae—Rush Family

Juncus tenuis ----------------------Slender Rush
Juncus interior ---------------------Inland Rush
Juncus torreyi ---------------------Torrey's Rush
Juncus brachycarpus ---------------Short-fruited Rush
Juncus scirpoides ------------------Scirpus-like Rush
Juncus diffusissimus ---------------Diffuse Rush

Liliaceae—Lily Family

Allium mutabile ------------------Wild Onion
Allium nuttallii ------------------Nuttall's Wild Onion
Nothoscordum bivalve -------------Yellow False Garlic
Ornithogalum umbellatum ----------Star of Bethlehem
Frequently found escaped from gardens to vacant lots.
Yucca glauca ---------------------Soap Weed
Asparagus officinalis --------------Asparagus
Escaped from cultivation to vacant lots and along roads.
Polygonatum commutatum ---------Zigzag Solomon's Seal
Smilax hispida -------------------Smooth Solomon's Seal
Vagnera racemosa ----------------Hispid Greenbrier

Iridaceae—Iris Family

Sisyrinchium campestre------------Prairie Blue-eyed Grass

Orchidaceae—Orchid Family

Ibidium vernale -------------------Linear-leaved Ladies' Tresses.
A number of these plants were found in hills south of Idana.

Juglandaceae—Walnut Family

Juglans nigra ---------------------Black Walnut
Hicoria cordiformis ---------------Swamp Hickory
Several specimens found along creek near Broughton.

Salicaceae—Willow Family

Populus deltoides ------------------Cottonwood
Salix amygdaloides ----------------Peach-leaved Willow
Salix longifolia --------------------Sandbar Willow
Salix cordata ----------------------Heart-leaved Willow

Fagaceae—Beech Family

Quercus maxima -------------------Oak Tree
Growing in woods along Five-creek.
Quercus macrocarpa ---------------Burr Oak
Quercus muhlenbergii --------------Chestnut or Yellow Oak
Occasionally found in woods along creeks.

Ulmaceae—Elm Family

Ulmus americana ------------------American or White Elm
Ulmus fulva -----------------------Red Elm
Celtis occidentalis -----------------Hackberry

Moraceae—Mulberry Family

Morus rubra -----------------------Red Mulberry
Morus alba ------------------------White Mulberry
Toxylon pomiferum ----------------Osage Orange

Cannabinaceae—Hemp Family

Humulus lupulus ------------------Hop
Cannabis sativa -------------------Hemp

Urticaceae—Nettle Family

Urtica gracilis -------------------- Tall Wild Nettle
Urticastrum divaricatum ---------- Wood Nettle
Boehmeria cylindrica --------------- False Nettle
Parietaria pennsylvanica ----------- Pennsylvania Pellitory

Santalaceae—Sandalwood Family

Comandra pallida ------------------ Pale Comandra

Polygonaceae—Buckwheat Family

Rumex acetosella ------------------ Sourdock, Red Sorrel
Rumex altissimus ------------------ Tall Dock
Rumex patientia ------------------- Patience Dock, Monk's Rhubarb
Rumex occidentalis ---------------- Western Dock
Escaped from cultivation, poses under name of wild spinach.
Rumex crispus -------------------- Curled Dock
Rumex obtusifolius ---------------- Broad-leaved or Bitter Dock
Rumex persicarioldes -------------- Golden Dock
Polygonum aviculare -------------- Knotweed
Polygonum ramosissimum ---------- Buhy Knotweed
Polygonum tenue ------------------ Slender Knotweed
Tovara virginiana ----------------- Virginia Knotweed
Persicaria muhlenbergii ------------ Swamp Persicaria
Persicaria lapathifolia ------------- Dock-leaved or Pale Persicaria
Persicaria pennsylvanica ----------- Pennsylvania Pensicaria
Persicaria longistylis -------------- Long Styled Persicaria
Persicaria punctata ---------------- Water Smartweed
Tiniaria convolvulus --------------- Black Bindweed
Tiniaria scandens ----------------- Climbing False Buckwheat

Amaranthaceae—Amaranth Family

Amaranthus retroflexus ------------ Red Root Rough Pigweed
Amaranthus hybridus -------------- Spleen Amaranth
Amaranthus spinosus -------------- Spiny Amaranth
Abundantly found in one farmyard near Wakefield.
Amaranthus blitoides -------------- Prostrate Amaranth
Amaranthus graecizans ------------ Tumbleweed
Amaranthus hypochondriacus ------- Princess Feather
Escaped from cultivation.
Acnida tamariscina ---------------- Western Water Hemp
Froelichia gracilis ----------------- Slender Froelichia

Chenopodiaceae—Goosefoot Family

Chenopodium album --------------- Lamb's Quarters
Chenopodium leptophyllum --------- Narrow-leaved Goosefoot
Chenopodium boscianum ----------- Bosc's Goosefoot
Found in low woods only.

Chenopodium hybridum ------------Maple-leaved Goosefoot
Chenopodium ambrosioides ---------Mexican Tea
Cycloloma atriplicifolium ----------Winged Pigweed
Kochia' scoparia -------------------Kochia (Mexican Fireweed)
Monolepis nuttaliana --------------Monolepis
Salsola pestifer -------------------Russian Thistle

Phytolaccaceae—Pokeweed Family

Phytolacca americana --------------Pokeberry

Nyctaginaceae—Four O'Clock Family

Allionia linearis ------------------Narrow-leaved Umbrellawort
Allionia nyctaginea ----------------Heart-leaved Umbrellawort

Aizoaceae—Carpetweed Family

Mollugo verticillata ---------------Carpetweed

Portulacaceae—Purslane Family

Portulaca oleracea -----------------Purslane
Portulaca grandiflora --------------Garden Portulaca
Occasionally found in lawns and waste places.
Escaped from cultivation.

Alsinaceae—Chickweed Family

Alsine media ----------------------Common Chickweed
Cerastium brachypodum ------------Short-stalked Chickweed

Caryophyllaceae—Pink Family

Silene stellata ---------------------Starry Campion
Silene antirrhina -------------------Sleepy Catchfly
Silene noctiflora --------------------Night-flowering Catchfly
Saponaria offininalis ---------------Bouncing Bet
Vaccaria vaccaria ------------------Cow Cockle

Ceratophyllaceae

Ceratophyllum demersum ----------Hornweed, Hornwort

Ranunculaceae—Crowfoot Family

Delphinium ajacis -----------------Rocket Larkspur
Delphinium virescens --------------Prairie Larkspur
Anemone decapetala ---------------Kansas Anemone
Anemone virginiana ---------------Tall Anemone
Occasionally found in moist and shaded woods.
Myosurus minimus ------------------Mouse Tail
Ranunculus abortivus --------------Kidney Crowfoot
Ranunculus sceleratus ------------Celery-leaved Crowfoot
Batrachium circinatum ------------Stiff White Water Crowfoot
Thalictrum dasycarpum ------------Tall Meadow Rue

Menispermaceae—Moonseed Family

Menispermum canadense -----------Canada Moonseed

Papaveraceae—Poppy Family

Argemone alba ---------------------White Prickly Poppy

Fumariaceae—Fumitory Family

Capnoides montanum --------------Mountain Corydalis

Brassicaceae—Mustard Family

Draba caroliniana ----------------Carolina Whitlow-grass
Draba brachycarpa ---------------Short-fruited Whitlow-grass
Camelina microcarpa --------------Small Fruited False Flax
Bursa bursa-pastoris --------------Shepherd's Purse
Radicula sinuata ------------------Spreading Yellow Cress
Radicula sessiliflora ---------------Sessile Flowered Cress
Sisymbrium nasturtium-aquaticum --True Water Cress
Lepidium virginicum --------------Wild Pepper Grass
Lepidium densiflorum --------------Wild Pepper Grass
Thlaspi arvense -------------------Field Penny Grass
Sophia incisa ----------------------Western Tansy Mustard
Cheirinia repanda ------------------Repand Cheirinia
Erysimum officinale ---------------Hedge Mustard
Norta altissima --------------------Tall Sisymbrium (Tumbling Mustard)
Sinapis alba -----------------------White Mustard
Sinapis arvensis -------------------Wild Mustard (Charlock)
Brassica juncea --------------------Indian Mustard
Brassica campestris ---------------Wild Turnip

Capparidaceae—Caper Family

Polanisia trachysperma ------------Clammy Weed

Crassulaceae—Orpine Family

Penthorum sedoides ---------------Ditch Stonecrop

Grossulariaceae—Gooseberry Family

Ribes odoratum -------------------Golden or Flowering Currant
Grossularia missouriensis ----------Missouri Gooseberry

Platanaceae—Plane-tree Family

Platanus occidentalis ---------------Plane Tree, False Sycamore

Rosaceae—Rose Family

Potentilla monspeliensis -----------Rough Cinquefoil
Agrimonia parviflora ---------------Agrimony
Geum canadense -------------------White Avens
Rubus occidentalis -----------------Black Raspberry
Rosa blanda -----------------------Smooth or Meadow Rose
Rosa practincola -------------------Arkansas Rose

Prunaceae—Plum Family

Prunus americana ------------------Wild Yellow or Red Plum
Prunus angustifolia ----------------Chickasaw Plum
Prunus mahaleb -------------------Mahaleb Cherry
Found two specimens about 7 to 8 feet high on a limestone cliff near Wakefield.
Prunus virginiana ------------------Choke Cherry

Mimosaceae—Mimosa Family

Acuan illinoensis ---------------- Illinois Mimosa

Morongia uncinata ---------------- Sensitive Brier

Caesalpinaceae—Senna Family

Cercis canadensis ---------------- Redbud

Abundantly found in woods along Five creek.

Cassia medsgeri ---------------- Medsger's Wild Senna

Chamaecrista fasciculata ---------------- Partridge Pea

Gleditsia triacanthos ---------------- Honey Locust

Gymnocladus dioica ---------------- Kentucky Coffee Tree

Tree, frequent in woods.

Fabaceae—Pea Family

Baptisia australis ---------------- Blue False Indigo

Herb common on dry prairies.

Baptisia bracteata ---------------- Large-bracted Wild Indigo

As frequently found as the foregoing.

Crotalaria sagittalis ---------------- Rattlebox

Mostly found in dry open places.

Medicago sativa ---------------- Alfalfa

Medicago lupulina ---------------- Black Medic

Melilotus alba ---------------- White Sweet Clover

Melilotus officinalis ---------------- Yellow Sweet Clover

Trifolium pratense ---------------- Red Clover

Trifolium repens ---------------- White Clover

Hosackia americana ---------------- Prairie Birdsfeet Trefoil

Psoralea tenuiflora ---------------- Few-flowered psoralea

Psoralia linearifolia ---------------- Narrow-leaved Psoralea

Psoralea digitata ---------------- Digitate Psoralea

Psoralea argophylla ---------------- Silverleaf Psoralea

Psoralea cuspidata ---------------- Large-bracted Psoralea

Psoralea esculenta ---------------- Indian Breadroot

Amorpha fructicosa ---------------- False Indigo

Amorpha canescens ---------------- Lead Plant

Parosela enneandra ---------------- Slender Parosela

Parosela aurea ---------------- Golden Parosela

Petalostemum oligophyllum ---------------- Slender White Prairie Clover

Petalostemum purpureum ---------------- Purple Prairie Clover

Cracca virginiana ---------------- Wild Sweet Pea

Found on sandy slopes of hills south of Idana.

Robinia pseudo-acacia ---------------- Black Locust

Geoprumnon mexicanum ---------------- Larger Ground Plum

Geoprumnon plattense ---------------- Platte Milk Vetch

Astragalus carolinianus ---------------- Carolina Milk Vetch

Found along streams in moist places.

Astragalus missouriensis ----------- Missouri Milk Vetch
Common in dry prairies.
Oxytropis lamberti --------------- Stemless Loco or Crazyweed
Glycyrrhiza lepidota --------------- Wild or American Licorice
Meibomia illinoensis --------------- Illinois Tick-trefoil
Lespedeza capitata --------------- Round-headed Bush Clover
Vicia sparsifolia ------------------ Narrow Leaved American Vetch
Lathyrus sp. --------------------- Lathyrus
A herbaceous vine, found in moist weeds along fresh running water.
Apios tuberosa ------------------ Ground Nut
Falcata comosa ------------------ Wild or Hog Peanut
Strophostyles pauciflora ----------- Small Wild Bean

Geraniaceae—Geranium Family

Geranium carolinianum ------------- Carolina Cranesbill

Oxalidaceae—Wood Sorrel Family

Oxalis violacea ------------------- Violet Wood Sorrel
Oxalis stricta -------------------- Upright Yellow Wood Sorrel
Oxalis bushii --------------------- Bush's Yellow Wood Sbrrel
Oxalis rufa ----------------------- Red-leaved Wood Sorrel

Linaceae—Flax Family

Linum usitatissimum -------------- Linseed
Found frequently in cultivation and escaped to roadsides.
Linum sulcatum ------------------ Grooved Yellow Flax

Balsaminaceae—Jewelweed Family

Impatiens biflora ----------------- Wild Touch-Me-Not
Abundantly found in low woods near Clay Center only.

Zygophyllaceae—Caltrop Family

Tribulus terrestris ----------------- Ground Burnut
Spreading more and more throughout the county, especially in the cities.

Rutaceae—Rue Family

Zanthoxylum americanum ---------- Prickly Ash
A shrub, occasionally found in woods along Five Creek.

Simarubaceae—Ailanthus Family

Ailanthus altissima --------------- Tree-of-Heaven
Abundantly found in cultivation as well as escaped from it.

Polygalaceae—Milkwort Family

Polygala verticillata -------------- Whorled Milkwort
Polygala alba -------------------- White Milkwort

Euphorbiaceae—Spurge Family

Croton glandulosus --------------- Glandular Croton
Croton capitatus ----------------- Capitate Croton, Hogwort

Croton monanthogynus ------------Single-fruited Croton
Croton texensis -----------------Texas Croton
Acalypha virginica ---------------Virginia Three-seeded Mercury
Tragia ramosa ------------------Branching Tragia
Chamaesyce serpens --------------Spreading Spurge
Chamaesyce glyptosperma ---------Ridge-seeded Spurge
Chamaesyce maculata ------------Spotted Spurge
Chamaesyce preslii ---------------Upright Spotted Spurge
Zygophyllidium hexagonum --------Angled Spurge
Tithymalopsis corollata -----------Flowering Spurge
Dichrophyllum marginatum --------Snow-on-the-Mountain Spurge
Tithymalus missouriensis ----------Reticulate-seeded Spurge
Tithymalus cyparissias -------------Cypress Spurge
Found escaped from gardens to roadsides.
Poinsettia cuphosperma ------------Warty Spurge
Poinsettia dentata ----------------Toothed Spurge
Poinsettia heterophylla ------------Various-leaved Spurge

Callitrichaceae—Water Starwort Family

Callitriche palustris --------------Vernal Water Starwart

Anacardiaceae—Sumac Family

Rhus glabra ---------------------Smooth Sumac
Rhus trilobata -------------------Poison Ivy, Poison Oak
Toxicodendron radicans ------------Ill-scented Sumac

Celastraceae—Staff Tree Family

Euonymus atropurpureus -----------Burning Bush, Wahoo
Celastrus scandens ----------------Climbing Bittersweet

Aceraceae—Maple Family

Acer saccharinum -----------------Silver Maple
Common along the Republican river.
Acer negundo --------------------Boxelder

Aesculaceae—Buckeye Family

Aesculus glabra arguta ------------Western Buckeye

Sapindaceae—Soapberry Family

Cardiospermum halicacabum --------Balloon Vine
Apparently escaped from cultivation.

Vitaceae—Grape Family

Vitis vulpina ----------------------Riverside Grape
Parthenocissus quinquefolia --------Virginia Creeper

Rhamnaceae—Buckthorn Family

Ceanothus americanus -------------New Jersey Tea
Ceanothus ovatus -----------------Smaller New Jersey Tea

Tiliaceae—Linden Family

Tilia glabra -----------------------American Linden
Occasionally found in rich woods along Five Creek.

Malvaceae—Mallow Family

Althaea rosea ____________________Hollyhock
    Often found in waste places.
Malva rotundifolia ________________Dwarf Mallow
Callirhoe alceoides ________________Light Poppy Mallow
Callirhoe digitata _________________Fringed Poppy Mallow
Callirhoe involucrata ______________Purple Poppy Mallow
Malvastrum coccineum _____________Red False Mallow
Sida spinosa _____________________Prickly Sida (False Mallow)
Abutilon abutilon _________________Indian Mallow
Hibiscus trionum _________________Bladder Ketnia, Flower-of-an-Hour

Hypericaceae—St. John's-wort Family

Hypericum mutilum _______________Dwarf St. John's Wort
    Common in swamps.
Hypericum majus _________________Larger St. John's Wort
    Occasionally found in swamps.

Elatinaceae—Waterwort Family

Bergia texana ____________________Texas Bergia

Violaceae—Violet Family

Viola papilionacea ________________Hooded Blue Violet
Viola latiuscula __________________Broad-leaved Wood Violet
Viola pedatifida __________________Larkspur Violet
Viola rafinesquii _________________Field Pansy

Loasaceae—Loasa or Evening Star Family

Mentzelia oligosperma _____________Stick Leaf

Cactaceae—Cactus Family

Coryphantha missouriensis _________Nipple Cactus
Opuntia humifusa _________________Western Prickly Pear

Lythraceae—Loosestrife Family

Ammannia coccinea ________________Long-leaved Ammannia
Ammannia auriculata ______________Wright's Ammannia

Onagraceae—Evening Primrose Family

Isnardia palustris ________________Marsh Purslane
Ludwigia alternifolia ______________Seedbox
Epilobium lineare ________________Linear-leaved Willow Herb
Oenothera biennis ________________Common Evening Primrose
Raimannia laciniata _______________Cut-leaved Evening Primrose
Hartmannia speciosa ______________Showy Primrose
Megapterium missouriense __________Missouri Primrose
Meriolix serrulata ________________Teeth-leaved Primrose
Gaura parviflora _________________Small-flowered Gaura
Gaura coccinea __________________Scarlet Gaura
Gaura biennis ___________________Biennial Gura
Stenosiphon linifolium _____________Flax-leaved Stenosiphon

Ammiaceae—Carrot Family

Eryngium sp. --------------------Erynge

Restricted to one plant found in cultivation probably imported with garden seeds.

Sanicula canadensis --------------Black Snakeroot

Washingtonia longistylis ----------Sweet Cicely

Sparingly growing in woods along water courses.

Cogswellia foeniculacea ------------Hairy Parsley

Spermolepis patens ---------------Spreading Spermolepis

Conium maculatum ----- ----------Poison Hemlock

Found in waste places and much cultivated under name of "Summer Fern".

Berula erecta --------------------Cut-leaved Water Parsnip

Found in swamps and streams.

Cicuta maculata ------------------Water Hemlock

Cornaceae—Dogwood Family

Cornus asperfolia ----------------Rough-leaved Dogwood

Primulaceae—Primrose Family

Androsace occidentalis -------------Androsace

Lysimachia nummularia -----------Money-wort, Creeeping Charlie

Escaped from cultivation.

Steironema ciliatum ---------------Fringed Loosestrife

Oleaceae—Olive Family

Fraxinus americana ---------------White Ash

Gentianaceae—Gentian Family

Gentiana puberula ---------------Downy Gentian

Frequently found throughout the county on prairies and meadows.

Apocynaceae—Dogbane Family

Apocynum cannabinum ------------Indian Hemp

Asclepiadaceae—Milkweed Family

Asclepias tuberosa ----------------Butterfly Weed

Aesclepias incarnata --------------Swamp Milkweed

Asclepias amplexicaulis ------------Blunt Leaved Milkweed

Asclepias syriaca -----------------Common Milkweed, Silkweed

Aesclepias speciosa ----------------Showy Milkweed

Asclepias verticillata --------------Whorled Milkweed

Aesclepias pumila -----------------Low Milkweed

Aesclepiodora viridis --------------Oblong-leaved Milkweed

Acerates viridiflora ---------------Milkweed

Acerates angustifolia -------------Milkweed

Gonolobus laevis ---------- -------Sand Vine

Convolvulaceae—Morning Glory Family

Quamoclit coccinea ---------------Small Red Morning Glory

Ipomoea purpurea ----------------Morning Glory

Ipomoea hederacea ---------------Ivy-leaved Morning Glory

Convolvulus sepium ---------------Hedge Bindweed
Convolvulus repens ---------------Trailing Bindweed
Convolvulus arvensis ---------------Small Bindweed, Field Bindweed

Cuscutaceae—Dodder Family

Cuscuta polygonorum ---------------Smart Weed, Dodder
Cuscuta paradoxa ---------------Glomerate, American Dodder

Polemoniaceae—Phlox Family

Phlox divaricata ---------------Wild Blue Phlox
Common in gardens and escaped to vacant lots.

Hydrophyllaceae—Waterleaf Family

Nyctelea nyctelea ---------------Nyctelea

Boraginaceae—Borage Family

Cynoglossum officinale ---------------Hound's Tongue, Gypsy Flower
Lappula texana ---------------Stickseed
Lappula virginiana ---------------Virginia Stickseed
Mertensia virginica ---------------Virginia Cowslip
Occasionally found in cultivation.
Lithospermum arvense ---------------Wheat Thief, Corn Gromwell
Growing abundantly on one vacant lot in Clay Center.
Lithospermum linearifolium ---------------Narrow-leaved Puccoon
Onosmodium occidentale ---------------Western False Gromwell

Verbenaceae—Vervain Family

Verbena urticifolia ---------------Nettle-leaved Vervain
Verbena hastata ---------------Blue Vervain
Verbena stricta ---------------Hoary Vervain
Verbena bracteosa ---------------Large-bracted Vervain
Verbena canadensis ---------------Large Flowered Verbena
Lippia lanceolata ---------------Fog-fruit

Lamiaceae—Mint Family

Teucrium canadense ---------------American Germander
Isanthus brachiatus ---------------False Pennyroyal
Scutellaria lateriflora ---------------Blue Skullcap
Scutellaria parvula ---------------Small Skullcap
Found in upland prairies in dry and wet soil.
Marrubium vulgare ---------------Common Hoarhound
Agastache nepetoides ---------------Giant Hyssop
Nepeta cataria ---------------Catnip
Glecoma hederacea ---------------Ground Ivy
Prunella vulgaris ---------------Heal All
Rarely found in Clay county but growing abundantly along Osbourne Springs, Riley county.
Leonurus cardiaca ---------------Motherwort
Leonurus sibiricus ---------------Siberian Motherwort
Lamium amplexicaule ---------------Henbit

Salvia pitcheri --------------------Tall Sage
Salvia lanceifolia -----------------Lance-leaved Sage
Monarda fistulosa ----------------Wild Bergamot
Hedeoma hispida -----------------Rough Pennyroyal
Lycopus virginicus ---------------Bugle Weed
Lycopus americanus --------------Cut-leaved Water Hoarhound
Mentha spicata --------------------Spearmint
In cultivation and escaped.
Mentha piperita -------------------Peppermint
In cultivation and escaped.
Mentha canadensis ----------------American Wild Mint
In moist soil along water courses.
Perilla frutescens -----------------Perilla
Escaped from gardens to vacant lots.

Solanaceae—Nightshade Family

Physalodes physalodes -------------Apple-of-Peru
Found in Clay Center, apparently escaped from cultivation.
Physalis longifolia ----------------Ground Cherry
Physalis lanceolata ----------------Prairie Ground Cherry
Physalis virginiana ----------------Virginia Ground Cherry
Physalis heterophylla --------------Clammy Ground Cherry
Physalis comata -------------------Hillside Ground Cherry
Solanum nigrum -------------------Black Nightshade
Solanum carolinense --------------Horse Nettle
Solanum rostratum ----------------Buffalo Bur
Lycium halimifolium --------------Matrimony Vine
Datura stramonium ----------------Jimson Weed

Scrophulariaceae—Figwort Family

Verbascum thapus -----------------Great Mullen
Verbascum blattaria ---------------Moth Mullen
Linaria linaria ---------------------Butter-and-Eggs
Found in cultivation and escaped.
Scrophularia leporella -------------Hare Figwort
Pentstemon cobaea ----------------Cobaea Beard-tongue
Pentstemon grandiflorus -----------Large-flowered Beard-tongue
Occasionally found in the extreme eastern part of the county.
Collinsia verna --------------------Collinsia
Here and there cultivated in gardens.
Mimulus ringens -------------------Square Stemmed Monkey Flower
Conobea multifida -----------------Conobea
Bramia rotundifolia ---------------Round-leaved Hedge Hyssop
Found in muddy water.
Ilysanthes dubia -------------------False Pimpernel
Found in wet places.

Veronica anagallis-aquatica ---------Water Pimpernel
Abundantly growing in a brook in the northeastern part of county.
Veronica peregrina ----------------Purslane Speedwell
Agalinis aspera -------------------Rough Purple Agalinis
Found growing in dry prairies.
Agalinis skinneriana ---------------Skinner's Agalinis
Found in wet places.

Bignoniaceae—Trumpet Creeper Family

Bignonia radicans -----------------Trumpet Creeper
Catalpa catalpa -------------------Catalpa
Catalpa speciosa ------------------Western Catalpa

Martyniaceae—Unicorn Plant Family

Martynia louisiana ----------------Unicorn Plant
Occasionally found in Clay county.

Acanthaceae—Acanthus Family

Ruellia strepens ------------------Smooth Ruellia
Found in open woods near Wakefield.
Ruellia ciliosa --------------------Hairy Ruellia
Abundant in prairies and meadows throughout the county.

Plantaginaceae—Plantain Family

Plantago major -------------------Common Plantain
Plantago lanceolata ----------------Ribwort
Plantago purshii ------------------Pursh's Plantain
Plantago aristata ------------------Large-bracted Plantain
Plantago virginica -----------------Dwarf Plantain

Phrymaceae—Lopseed Family

Phryma leptostachya ---------------Lopseed

Rubiaceae—Madder Family

Houstonia augustifolia -------------Narrow-leaved Houstonia
Cephalanthus occidentalis ----------Button Bush
Galium aparine --------------------Bedstraw
Galium circaezans -----------------Cleavers
Galium concinnum -----------------Shining Bedstraw

Caprifoliaceae—Honeysuckle Family

Sambucus canadensis ---------------American Elder
Symphoricarpes symphoricarpes -----Coral Berry, Indian Currant

Cucurbitaceae—Gourd Family

Pepo foetidissima ------------------Calabazilla, Wild Pumpkin
Micrampelis lobata -----------------Wild Balsam Apple
Sicyos angulatus -------------------Star Cucumber

Campanulaceae—Bellflower Family

Campanula americana --------------Tall Bellflower
In woods and moist thickets near Wakefield.
Specularia perfoliata --------------Venus' Lookingglass

Specularia leptocarpa ---------------Western Venus' Lookingglass

Lobeliaceae—Lobelia Family

Lobelia cardinalis ------------------Red Cardinal Flower
Lobelia syphilitica ------------------Great Blue Lobelia

"Compositae"

Cichorium intybus -----------------Chicory
Along roadsides and waste places near cities only.
Tragopogon pratensis ---------------Yellow Salsify
Tragopogon porrifolius -------------Oyster Plant
Leontodon taraxacum ---------------Dandelion
Sonchus oleraceus -----------------Annual Sowthistle
Sonchus asper ---------------------Spiny Sowthistle
Lactuca ludoviciana ----------------Western Lettuce
Lactuca canadensis -----------------Wild Lettuce
Lactuca sagittifolia ----------------Arrow-leaved Lettuce
Lactuca pulchella ------------------Large-flowered Blue Lettuce
Lactuca floridana ------------------Florida Lettuce
Growing in moist woods near Wakefield.
Lactuca spicata --------------------Tall Blue Lettuce
Lygodesmia juncea -----------------Rush-like Lygodesmia
Agoseris cuspidata -----------------Prairie False Dandelion
Sitilias grandiflora -----------------False Dandelion
Hieracium longipilum ---------------Long-bearded Hawkweed
Iva ciliata --------------------------Rough Marsh Elder
Iva xanthiifolia ---------------------Burweed Marsh Elder,
Ambrosia trifida --------------------Giant Ragweed
Ambrosia elatior --------------------Common Ragweed
Ambrosia psilostachya --------------Western Ragweed
Xanthium pennsylvanicum ----------Cocklebur
Vernonia interior -------------------Ironweed
Eupatorium altissimum -------------Tall Thoroughwort
Eupatorium urticaefolium ----------White Snakeroot
Eupatorium perfoliatum ------------Boneset
Kuhnia hitchcockii (?) -------------False Boneset
Lacinaria punctata ----------------Dotted Blazing Star
Lacinaria acidota ------------------Slender Button Snakeroot
(According to Britton & Brown, but not to Bush, who is giving it a new name.)
Lacinaria scariosa -----------------Large Blazing Star
Grindelia squarrosa ----------------Gum Plant
Chrysopsis stenophylla -------------Stiff-Leaved Golden Aster
Chrysopsis hispida -----------------Hispid Golden Aster
Prionopsis ciliata ------------------Prionopsis
Sideranthus spinulosus ------------Cut-leaved Sideranthus
Solidago petiolaris ------------------Downy Ragged Goldenrod
Solidago lindheimeriana ------------Lindheimer's Goldenrod

Solidago patula ---------------------Rough-leaved Goldenrod
Solidago serotina -------------------Late Goldenrod
Solidago glaberrima ----------------Missouri Goldenrod
Solidago gattingeri ------------------Gattinger's Goldenrod
Solidago altissima -------------------Tall Goldenrod
Solidago mollis -----------------------Velvety Goldenrod
Solidago rigida ----------------------Stiff Goldenrod
Euthamia gymnospermoides ---------Viscid Bushy Goldenrod
Aster drummondii -------------------Drummond's Aster
Aster sericeus ------------------------Western Silky Aster
Aster fendleri ------------------------Fendler's Aster
Aster multiflorus --------------------White Wreath Aster
Aster dumosus ----------------------Bushy Aster
Leucelene ericoides -----------------Heath Aster
Erigeron annuus --------------------Sweet Scabious, Daisy
Erigeron ramosus -------------------Daisy Fleabane
Leptilon canadense -----------------Canada Fleabane, Mare's Ttil
Leptilon divaricatum ---------------Dwarf Fleabane
Ionactis linarifolius ----------------Stiff Aster
Antenaria campestris ---------------Prairie Cat's-foot
Gnaphalium obtusifolium ----------Sweet or White Balsam
Gnaphalium palustre --------------- Western Marsh Cudweed
Silphium integrifolium --------------Entire-leaved Rosinweed
Silphium laciniatum ----------------Compass Plant

Found occasionally on prairies and along roadsides.

Verbesina alba ----------------------Yerba de tajo

Frequent in low places along river.

Rudbeckia hirta ---------------------Blackeyed Susan

Frequent along railroad tract and road east of Broughton.

Rudbeckia laciniata -----------------Tall Coneflower
Ratibida columnaris ----------------Prairie Coneflower
Echinacea angustifolia -------------Purple Coneflower
Helianthus annuus -----------------Common Sunflower
Helianthus petiolaris ---------------Prairie Sunflower
Helianthus scaberrimus ------------ Stiff Sunflower
Helianthus subrhomboideus ---------Rhombic-leaved Sunflower
Helianthus maximiliani -------------Maximilian's Sunflower
Helianthus tuberosus ---------------Jerusalem Artichoke
Ridan alternifolius ----------------- Wingstem, Yellow Ironweed
Bidens laevis -------------------------Larger Bur Marigold
Bidens comosa -----------------------Tickseed
Bidens frondosa ---------------------Beggar Ticks
Bidens vulgata -----------------------Tall Beggar Ticks
Bidens bipinnata ---------------------Spanish Needles

Thelesperma trifidum ---------------Thelesperma
Thelesperma gracile ----------------Rayless Thelesperma
Galinsoga parviflora ----------------Galinsoga
Frequent in waste places near cities.
Hymenopappus corymbosus ---------Hymenopappus
Hymenopappus flavescens -----------Woolly Hymenopappus
Gaillardia pulchella -----------------Showy Gaillardia
Occasionally found escaped from cultivation.
Boebera paposa --------------------Fetid Marigold
Achillea millefolium ----------------Yarrow
Anthemis cotula ---------------------Mayweed
Chrysanthemum leucanthemum ----Field Daisy
Escaped from cultivation.
Chrysanthemum balsamita ----------Costmary, Sweet Mary
Matricaria matricarioides -----------Rayless Camomile
Found in vacant lots.
Tanacetum vulgare -----------------Tansy
Occasionally found in vacant lots, escaped from cultivation.
Artemisia caudata ------------------Tall or Wild Wormwood
Artemisia dracunculoides ---------- -Linear-leaved Wormwood
Artemisia annua --------------------Annual Wormwood
Artemisia biennis ------------------Biennial Wormwood
Artemisia ludoviciana --------------Dark-leaved Mugwort
Mesadenia tuberosa ----------------Indian Plantain
Senecio pauperculus ---------------Groundsel
Arctium minus ----------------------Common Burdock
Cirsium altissimum -----------------Tall or Roadside Thistle
Cirsium undulatum ---------------- Wavy-leaved Thistle
Cirsium ochrocentrum --------------Yellow-spined Thistle
Centaurea cyanus ---------------- -Bachelor's Button
Escaped from gardens.

WHAT MOVING FORCES ARE FOUND IN THE FOLLICLES OF THE ORTHOPTERAN TESTES?

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Many of the manifestations of the moving forces in mitosis are well recognized and have been studied for a long time. There is the separating of the centrioles and their movement of 180° around the nucleus. There is the movement of the chromosomes to the equatorial plate and then on to the poles. We are immediately forced to ask what are the forces which give rise to these movements. Wilson (1925), in his classical work on the cell, says that a consideration of the energies at work in mitosis leads into one of the most difficult fields of cytological inquiry; and that, after forty years of study, we have taken but the first steps.

But we have, at least, several well formulated theories which seek to explain the inciting forces behind these movements. Each has its ardent group of supporters. Among these the earliest is the theory of "fibrillar contractility" as sponsored by Klein (1878) and Boveri (1900). Another is that of "protoplasmic flow" or diffusion sponsored by Butschli and Rhumbler. A third postulates electrical polarities in the protoplasmic fields. (See Hartog, 1914) and R. Lillie, 1905). But Wilson rightfully summarizes that none of these hypotheses affords a satisfactory conclusion to the problem although each has contributed interesting suggestins.

A second group of movements is called telekinetic and includes those which affect the polarized grouping of the spermatid components. Wilson lists them as follows:

1. The rotation of daughter chromosome plates.
2. The movement of centrioles to the posterior pole of the spermatid nucleus.
3. Movement of the nebenkern also to the posterior pole.
4. Passage of the acrosome, sometimes first to the posterior pole and then to the anterior pole of the spermatid nucleus.

Again we have little explanation of these movements. Bowen says that the growth, or namely, the stretching of the spindle fibers turns the chromosome plates and causes the apparent movement of the centrioles to the posterior pole of the forming spermatid. I have confirmed this stretching of the spindle in Nemobius fasciatus (Baum-

gartner, 1929). This would account for some of these shifting movements of the parts in the spermatid. But is this stretching of the spindle a growth? And is it an explanation to say that it grows?

There is another series of observations which might be considered as movements, although no one has thought of them in this connection. Here I should list:

1. The elimination of certain elements out of the nucleus and the subsequent elongation of the nucleus. This elongation sometimes is carried very far.
2. The concentration of the mitochondria into the nebenkern, its division and movement and distribution down along the axial filament forming a tail sheath.
3. A division of the centrioles which may occur and the growth of the axial filament from it or them. Sometimes one of them may move out along the axis cylinder forming the middle piece or in a few cases, move along the nucleus to the head end. See Goldsmith (1919), Charlton (1921) and Baumgartner (1929).
4. The division of the acrosome and the sliding of one part down the tail.

What may we say of the forces behind these movements? The formation of the axial filament is a "growing out" from the centrioles. The concentration of the nucleus is a giving up of water. Probably the formation of the nebenkern is likewise a concentration. But what makes it divide in some species? What makes it slide down the axial filament and form its sheath? What causes the centriole to send out the axial filament? What makes it divide and send one part down the axial filament thus forming the middle piece? What makes the Acrosome move first to the posterior end and then to the anterior end? As Wilson has said so pointedly in another connection "merely to quote such problems is to force a confession of abysmal ignorance".

I wish particularly to call attention to an additional group of movements which have not been described, and scarcely noted, by investigators. These are to be observed for the most part in the Orthopteran testes.

1. The elongation of the cytoplasm in the early spermatid.
2. The movement of the nucleus to the distal end of the cell, that is, the end of the elongating cell farthest from the center of the cyst.

3. The great elongation of the cysts as the forming sperm elongate.

4. The turning of these nuclear-head ends of the newly forming sperm toward the blind end of the Orthopteran follicle, except in the species, Nemobius fasciatus (Baumgartner, 1929) and Locusta virridisima (Otto, 1907).

5. The turning of the mature or almost mature sperm in the follicles of most species as reported by Baumgartner. (1930;.

6. The movement of the mature or maturing sperm out of the follicles into the vasa efferentia.

Of the forces concerned in this last list of six movements we could say that they are "growth movements" or "accomodation movements" for the elongation of the sperm or their transportation. But such an answer says little or nothing. What force suddenly enters the cells in a cyst to make them elongate, arrange themselves radially and push their nuclei to the outer ends of the base of the pyramidal shape they are assuming? Are the nuclei pushed to one end by the growth of the axial filament? Is it protoplasmic flow? Is the nucleus drawn toward the cyst wall by some chemical force, perhaps, a need for nourishment, or is it forced into the broad base by the flowing cytoplasm and the contracting walls of the cell? Are the elongating sperm, turned in most Orthoptera toward the blind end of the follicle in the early stages, attracted by some force coming from that end? May it be nourishment that comes thence? If this be true, does that nourishment later arise in the open end and thus explain the subsequent turning of the sperm in these forms? This might be called a reversal of the source of nourishment. The turning of the sperm in different stages of development would support such an interpretation. If we grant such a reversal, the nourishment source in N. fasciatus and L. vissidisma must lie at the open end of the follicle from the beginning of the elongation for in these forms the sperm are turned in that direction from the beginning. Do the growing tails cause the cysts to change their shape and send long points down the center of the follicle? Do the sperm turn and move out of the follicles by the vibratory movement of their tails? Evidence is accumulating in our laboratory at the present time that this may be the case. Do follicular walls aid in the turning and movement of the sperm by contraction? Observations by a new technique on living material in our laboratory are bringing evidence that the walls do contract and Baumgartner and Paynee (in press) have found striations in living and fixed follicular walls. The details of these findings are now being studied.

It is thus easy to see that our observations are not sufficient and explanation of them inadequate—and that we are again forced to admit almost "abysmal ignorance". The forces that may be active in these movements I have preferred to suggest in the form of queries rather than statements, as all are of too uncertain a nature for positive statement.

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ARCHEOLOGICAL NOTES ON THE FORT APACHE REGION, ARIZONA

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Introduction

The following pages are the results of studies carried on at intervals during the writer's stay on the White Mountain Apache reservation as government farmer.

Archibald R. Marvine passed through the region from the Little Colorado river via Camp (Fort) Apache and San Carlos to the Gila river in 1871; and G. K. Gilbert visited it in 1873, both making a geological reconnaissance of the country,[1] as did the writer while farmer there.[2] Bandelier[3], Walter Hough[4], and Spier[5], also described the antiquities of the region, while the Gates Expedition examined ruins on Forest Dale creek and along White river in 1901[6]; and the Smithsonian institution at an earlier date exhumed human skeletons from caves in the vicinity of Fort Apache. On the whole, however, the region was barely touched.

A complete bibliography may be found in Bulletin 35 of the Bureau of American Ethnology, pages 90 to 96, to which readers are referred. Also see Bulletin 54 of the same Bureau, pages 73 to 76.

General Description

The Fort Apache region is in east central Arizona between longitude 109 degrees, 30 minutes and 111 degrees, 10 minutes W.; between latitude 33 degrees and 34 degrees 20 minutes N. Rougly speaking it is a trapezium in form, its longest line being at the southwest, its shortest on the east. Its margin on the north is formed by the Mogollon range, on the east by the White mountains, on the southwest by the Pinal and Sierra Ancha mountains and the Tonto basin, and on the southeast by Black river and the Nantanes and Apache mountains.[7]

. See Volume III of the U. S. Geological Survey West of 100 Meridian.

2. Reagan, Albert B.; Geology of the Fort Apache Region, Arizona: American Geologist, Vol. 32 pp. 267-308.

3. Bandelier; Final Report, Part 2.

4. Hough, Walter; Bulleton 35, Bureau of American Ethnology, 1907.

5. Archeological Field Work in Western Arizona, the Museum-Gates Expedition of 1901, Ann. Report, U. S. Nat. Museum for 1901, pp. 287-358, 1903.

6. Spier, Leslie; Ruins in the White Mountains, Arizona: Anthropological Papers of the American Museum of Natural History, Vol. 18, Part 5, pp. 367-387.

7. The rock formations exposed in the region are as follows: The Post-glacial, Quaternary, Tertiary, Cretaceous, Carboniferous (Coconino—Pennsylvania, possibly including Kaibab limestone toward the north, Supla—Pennsylvanian in age, and Red Wall Mississippian in age), Devonian (Martin Limestone). Ordiviclan(?) Cambrian—Tonto-Apache Group (Troy Quartzite, Mescal Limestone, Dripping Springs Quartzite, Barnes Conglomerate, Pioneer Shale, Scanlan Conglomerate), and older Pre-Cambrian Gneiss and schists, often called the Pinal Schists, and Granite and allied rocks).

The fossils so far identified from the region are: Lower Silurian (Ordivician?): Orthis davidsoni, Strombodes pentagonus; Devonian (Martin Limestone): Orthis

ANTIQUITIES

For a long period of time this region was inhabited by a pueblo-building, cliff dwelling race that was extinct when Coronado visited the country, unless some of the Pueblo tribes of New Mexico and Arizona are their descendants. The region is dotted with ruins of villages and cliff houses. Ancient irrigating ditches and evidence of cleared land also are noticeable. That the region was once more densely populated than now, is evidenced on every hand. It is quite likely that 5,000 to 10,000 people once lived within its confines. Where they came from and why they went away is a matter of conjecture which probably only a Fewkes can solve. From the records of the Coronado expedition it appears that no race of men occupied the section when the Spaniards entered it. For more than two hundred and fifty years it has been the home of the Apaches.

As has been stated, the region was visited by Bandelier and the Gates Expedition, and its antiquities have been written up by Dr. Walter Hough. (Op. cit. pp. 79-82). Dr. Hough's notes will be given with the author's additional observations. The numbered villages are the same as those described in Dr. Hough's report. The lettered ones are the additional villages examined by the writer. The part inclosed in quotation marks is copied from Hough's report, pages 79-82.

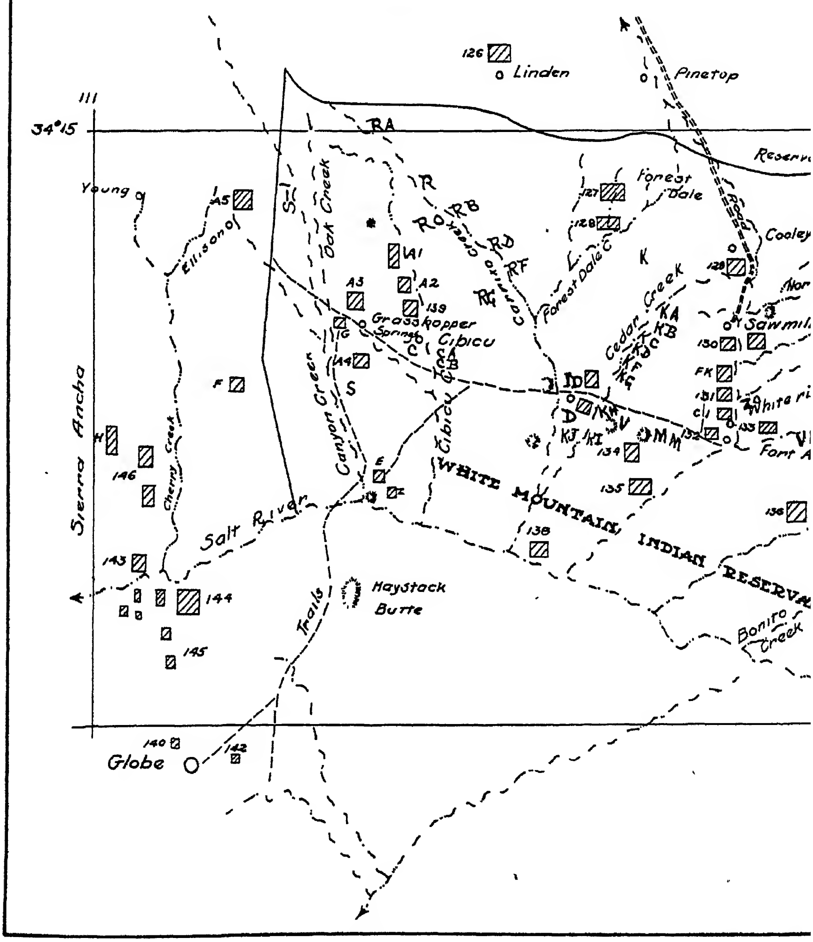
THE ESCARPMENT, PLATEAU AND FORT APACHE DISTRICT

" White Mountain creek (White river) has its origin in the 'rim' southeast of the town of Pinetop, Navajo county, Arizona. On the upper reaches of the creek are caves and small stone structures which were probably hunting lodges, the country being too high and rough for permanent habitation. Lower down the stream, between Cooley's and Fort Apache, are a number of rectangular pueblo ruins, and near the post are extensive caves, which formerly were used as burial places and contained until a few years ago many desiccated human bodies.

"West of White Mountain creek on Forest Dale creek is a group of very large pueblos, one of which is of circular form and on Cedar creek, a tributary of Carrixo, a large ruin due north of Silver Ball peak is reported. A number of these pueblos were explored by the Museum-Gates expedition of 1901. To the west on Cibicue creek, a tributary of Salt (Black) river are other large stone pueblos like those at Forest Dale; these have not been examined. Other creeks descending from the 'rim' into Salt River will doubtless show, on investigation, sites of ancient habitations." (Hough, op. cit., 79).

livia, Spirifer fornicula and Acervularia davidsoni; Carboniferous (Supai—Pennsylvanan in age): Calamites cannaeformis, Lepidodendron, Spirifer cameratus, Productus semireticulatus, P. Costatus; Carboniferous (Coconino and Kaibab ?)): Spirifer cameratus, Athyris subtilita, Productus punctatus, Productus sp., and Bellerophon.

ARCHAEOLOGICAL MAP OF THE FORT APACHE REGION, ARI



Above Fort Apache, on Salt River, are pueblos and caves which have been disturbed by curiosity seekers. So far as is known, the upper stretches of this river contain no ruins, since it runs through elevated and extremely broken country from its head in Escudilla peak.

"126 **Pueblo.*** Near Linden, 45 miles south of Holbrook, Navajo county, Arizona, is a pueblo called Pottery Hill. This pueblo lies on the divide between the Little Colorado and Salt River. It is quite large and appears to be quite ancient. There are large quantities of banded, coil, red and gray ware here. The site was explored by the Museum-Gates expedition of 1901. Another pueblo with large circular kiva lies one mile south of this ruin. (Report of United States National Museum, 297, 1901)". (Hough, op. cit., 80).

"No. 127. **Pueblos.** On Forest Dale Creek ten miles southeast of Showlow and three miles east of Pinetop, White Mountain Apache reservation, is a group of four ruins located in the lowland or hill slope along the creek. Two of these ruins are very large; the main ruin, seven acres in extent, is composed of a circular acropolis with rectangular additions and was explored by the Museum-Gates expedition in 1901. (Op. cit., 287)." (Hough, op. cit., 80).

"No. 128. **Hill-Top Fort.** On the summit of a high knoll above Forest Dale Creek and one mile from ruin No. 127 is a stone structure which appears to have been used as a fort. The walls are laid up of dry masonry. There are no pottery fragments or other artifacts in this place."[8] (Hough, op. cit. 80).

"129. **Pueblo.** Near the Interior sawmill, a few miles south of Cooley's, White Mountain Apache reservation, is a small ruin built of basalt blocks. It lies on the level ground above White Mountain creek (White River) in cultivated fields. The pottery is grey and

*Only the principal ruins are given on the map and the others are this and that distance from these.

8. While the Museum-Gates expedition was exploring the ruins at Forest Dale the writer, who was then Indian farmer at Fort Apache, chanced to visit one of the Indian camps and while there conversation ranged over various subjects. At last the writer turned to the medicine man and said that he wished to ask him a question, if it would not be too much for him to answer it for him.

"Go on," commanded the medicine man. "I will tell you about anything I know about."

"Well," the writer resumed, more confidently," in many places in your country there are ruined villages. There are the villages at Forest Dale that the white men are digging up many in this valley, quite a number at Cibicue, one at Cedar creek, one at Grasshopper springs, one at Ellison, a walled village in the timber southwest of Grasshopper springs, and many more scattered here and there. Who were these people and what became of them?"

The old man frowned and spat in the fire in contempt. Then he turned a piercing eye upon the writer and said: "Brother, we do not wish to talk about that people. They overran this country many, many, suns ago and overpowering our people, made slaves of them all. For many, many years our people were their slaves and did all their work for them. They had a big chief who lived under the noonday sun. Once upon a time this big chief had a great war in his southland home; and being hard pressed, he sent officers throughout his realms calling his warriors to his capital to help repel the foe After they had departed, our people rose against the women and children and old men and massacreed them all and destroyed their places of habitation as you have seen them. Since that time we have been slaves to no race of men. No, we do not like to talk about these people." Again he spat in the fire in contempt, then became silent.

brown, and there is some coiled ware showing fine work. This ruin was explored by the Museum-Gates expedition of 1901. (Op. cit., 29i)" (Hough, op. cit., 80).

While building the bridge across the canyon just south of the Interior sawmill mentioned, the writer often visited this ruin. It is in the inner valley of White River some two hundred feet below the top of the mesa-bench adjacent and something like one hundred yards east of the mesa-wall, in cultivated fields on the west side of the river. It is arranged in horseshoe shape, though having somewhat square shoulders. The opening between the toes of the shoe is at the east. There also seemed to be the remains of a building in the entrance-way which seems to have been a watch tower. The small size of the ruin seems to indicate that it never had more than 120 inhabitants.

Besides this ruin, the mesa-walls wherever perpendicular or overprojecting are smoked and show every indication that there had been placed against them places of habitation of destructible material which has been removed by time, leaving only smoked rocks to tell of those far-off days.

"**No. 130. Pueblos.** Along White Mountain creek, between Interior sawmill and Fort Apache are several rectangular stone ruins on the bench above the creek canyon. The mounds of these ruins stand high, but no walls are exposed. The pottery is gray, red, and coiled, and seems of inferior quality. Bandelier mentions these ruins." (Hough, op. cit., 80).

A part of these runs are situated on the Elsesa Travertine deposits (marked FK on the map). As the wagon rumbles over the hollow-sounding travertine on the Apache-Holbrook wagon road, these ancient pueblo mounds come to view one by one, the arrangement having a north and south trend. They were built of travertine blocks and none are large.

A small canyon cuts through the travertine here and on a north shelf under a projecting wall there have been several cliff houses. When the writer visited the place one small room still remained intact, and parts of the foundations of several other rooms could be traced. The walls were built of travertine. The roof was of poles overlain with brush and flags. A gray vase-pot was obtained from this room.

Along the inner valley of White River this traventine deposit forms a steep west wall more than one hundred feet in height. At places along this wall the travertine projects over the valley and under these places temporary abodes have also been made as is indicated by the smoked rocks. At a few places it would appear that the shelving had been made artificially. There are also a few small caves in this region that appear to have been used as bins and burial places.

"No. 131. **Pueblo.** Eight miles above Fort Apache, on the old Cooley ranch is a pueblo which is described by Bandelier (in op. cit., 294) and was examined by the Museum-Gates expedition of 1901." (Hough, op. cit., 80).

"No. 132. **Pueblo.** On the west bank of the north fork of White Mountain creek., about two miles east of Fort Apache is a ruin consisting of a hollow rectangle the sides of which measure about 40x50 yards. Some work has been done here in a small way. Bandelier describes the ruin as two stories high (Final Report, pt. 11, 396). The ware is commonly red with black decoration and frequently has black and white ornamentation on exterior of bowl." (Hough, op. cit., 80-81).

"No. 133. **Pueblo.** On the South bank of the creek three-fourths of a mile southeast of No. 132, is a large pueblo, measuring 50x80 yards. There has been sporadic excavation here. Further up the creek are two other ruins similar to No. 133 in pottery and artifacts." (Hough, op. cit., 81).

There appears to be some mistake about the location of Nos. 132 and 133. Number 132 is placed west of the north fork of White River about two miles east of Ft. Apache. As the north fork of White River runs nearly north from Fort Apache, the position of the ruin must be about two miles north and a little west of the fort instead of east of it. Village No. 133 is placed on the south bank of the creek (White River) three-fourths of a mile southeast of No. 132. It should have been placed on the east bank of the river. However, the writer saw no village on either site. He therefore concludes that the ruins are on the east fork of White river east of Fort Apache.

Hough's No. 132 is undoubtedly the large, rectangular pueblo, situated a mile and a half east of Fort Apache on the south side of East Fork just above the juncture with Seven Mile creek; and his No. 133 is a half mile east of that ruin, on high ground on the opposite side of East Fork. The first is about 200 feet by 170 feet, with a rectangular court 100 acres across, and the latter measures 115x90, also including a rectangular court. Sherds are not plentiful about either site.

No. Y A small-house ruin is situated across the river from No. 133.

No. ZO. Pueblo. A promontory of rock projects westward across the inner valley floor to the very brink of White river east of the north fork, a little northeast of the post office and the old agency buildings at Whiteriver. On the point are scattered rooms and what

appears to be a small village and the ruins of a watch tower, built of basalt. There are also pestle places in the bench rock where corn and pinon nuts probably were pounded, also arrow-straightening grooves. Some of the cliff faces are covered with pictographs. One photograph appears to be modern, as it contains a five-pointed star. Farther back on the bluff is a large ruin built of the same material. It is quite likely that the two villages were occupied at the same time and were continuous. These villages were occupied for a long period of time as is attested by the graveyard along the north slope of the ridge. The writer put in the irrigating ditch past this point in 1901 and in excavating, many graves were dug through. The burying was so long ago that the bones were so completely decayed that only traces could be found, but the artifacts and fragmentary pottery were plentiful. Grinding slabs seemed to have been the principal imperishable material buried with the women. Artifacts that had apparently been buried with the dead were found along the north slope of the ridge for about an eighth of a mile.

"No. 134. **Pueblo.** About four miles northeast of Fort Apache near the foot of Sawtooth mountain is a very large pueblo situated on both sides of a ravine in the bottom of which pines are growing. The location is about two and one-half miles north of White Mountain creek. Much excavation has been carried on here, but not systematically. Bandelier estimates that the two portions or villages held a population of 800 souls. (Op. cit., 396-397). "The village appears to be a small compact small-house settlement.------The wide vale on which the ruins are situated is without water for irrigation and I did not observe any provision made for storing, nor did I notice any estufas.' " (Hough, op. cit., 81).

It might be suggested that it is possible that the two villages were joined by a dam which impounded the water of the creek for home use and irrigation purposes as was done in the case of the village at Grasshopper springs, as will be mentioned later. Since the villages were abandoned the dam which was likely an earth bank, has been cut through and removed by stream and flood.

No. MK. Two small ruins of one room each show a quarter mile east of No. 135.

No. VMV. **Small-house ruins.** Four small-house ruins are on the bluff of East Fork about one-fourth of a mile west of East Fork Day School, and across East Fork from the school are three similar ruins. All are very small, containing from one to three rooms. A pueblo ruin also lies on the north side of East Fork about a mile east of the school, 119x72, built of lava boulders and sandstone. And about a mile farther up stream a small cliff house ruin, possibly having been only a storehouse, may be seen high up on the cliff face; and about

another mile up stream another pueblo ruin stands in the bottom land on the north side of East Fork, size about 60x162, with a court 59 feet square.

"No. 135. Fort. Two miles west of Fort Apache and 150 yards from the left bank of White Mountain creek (White River) is a construction which may have been a fort or a fort-lookout. It stands on a small mesa about 100 feet in height." (Hough, op. cit., 81).

This fort lookout is somewhat rectangular in shape and is built of volcanic blocks, conforming to the top of the mesa, 100 feet long by two or three rooms wide. Part of the ruin is also on a shoulder-bench of the peak. The pottery examined was black-on-white, black-and-white-on-red, and black-on-red, and corrugated.

The site of this ruin is now used as a place where the discarded medicine things of the Apaches are placed as an offering to the gods When Mr. Owen of the Field Columbian Museum purchased curios of these Indians in 1902. the writer went with the Indians to this ruin and helped secure several medicine staffs, thunder hats and medicine hats for the museum. The Indians said they wished him to accompany them to keep away the evil spirits while they were getting their offerings to their deities from the place of the "dead peoples."

No. AMML. Villages. A small ruin, 75x85, occupies a hilltop on the south side of White River a half mile west of the Day School. There are pictographs on the walls of the west face of the gorge of the river near here, above which there are two small-house ruins. Near the top of the mesa south of the river about a mile south of No. 135 there are several small-house ruins in the vicinity of the Chiricahua Beef Spring.

No. MM. About three miles west of Canyon Day School on the eastern foot of Kelly's Butte there is a small pueblo, measuring 119x54, with two outlying buildings of one and three rooms.

No. MN. This is a small pueblo ruin near Navajo Bill Spring, about eight miles west of Canyon Day School, about which there are several small-house ruins. The villages were built of lava blocks.

South of Black River below Turkey Creek and above White River there are said to be several caves and a few ruins. The writer saw three caves and four small ruins in this vicinity, which was said to be about half the number actually there.

In the triangular area between East Ford and Seven Mile Creek there are several small ruins, two of which were visited by the writer.

A small, irregularly shaped ruin, built of sandstone, occupies two small peaks on the east side of East Fork about straight east of the agency at Whiteriver. And some distance south of this just above the Whiteriver bridge there is another small ruin, now leveled. Ten rooms could be made out, as well as a circular kiva. The pottery of

both of these ruins was corrugated, black-on-white, black-on-red, and the latter ruin also had a little black and white-on-red pottery.

"No. 136. **Pueblo.** About fourteen miles southeast of Fort Apache is a large ruin showing a ground plan of more than 80 rooms. This ruin has not been disturbed." (Hough, op. cit., 81).

No. AZ. A small ruin, thirty-eight feet in length, stands on a rise north of the river, three-eights of a mile east of the Day School.

"No. 137. **Watch Tower.** Fifteen miles southeast of Fort Apache on a prominent butte is a structure which was reported to Bandelier. (Op. cit., 397). He surmises it to be a place of retreat and observation." (Hough, op. cit., 81).

"No. 138. **Cliff House and Partition Caves.** These are situated west of Fort Apache in the canyon of White Mountain creek. The extent of these houses was reported to Bandelier. (Op. cit., 397).

"There are many caves on the reservation that were used for burial and ceremonial purposes. One of these not far from the post contained numerous desiccated bodies which have been removed by collectors. The Field Museum of Natural History has many specimens from this cave. Noteworthy among objects found therein is a unique storage basket." (Hough, op. cit., 81).

This cave the writer will call No. A., next below.

No. A. Cave. As has been noted, this cave runs back north along a fissure (?) in the north wall of the East Fork of the White River quite a bit above the valley floor. It appears to be a natural cave. It is now composed of rooms, side passageways, corridors, halls, narrow passageways, walled storage chambers, and a burial site about 200 feet within. Some of the rooms and passageways have been enlarged by man. It seems to have been usd for different purposes at different times; a place of habitation, lodge room, a storage site and burial place. The latter seems to have been the use to which it was most put, as many skeletons have been found in it. The cave is so long and tortuous that people exploring it run a string of twine from the entrance along the passageways they traverse and also place candles at convient places along the way to insure a safe return. The Field Museum (?) obtained the greater part of the curios from this cave; the remainder fell into the hands of private parties.

The size of this cave has always been greatly exaggerated. The story of its discovery was related to the writer as follows:

"During the spring of 1899 Sergeant Geo. E. Price, who was with Troop G of the Seventh Cavalry, then stationed at Fort Apache, discovered this great cave while making researches about the country.

"A few miles east of the fort on White River rise some immense cliffs of red sandstone. From the glistening stream the cliffs rise

almost perpendicularly for several hundred feet. Crevices and little ledges of rock form the only footholds for daring climbers. While fishing for trout one day Sargeant Price noticed high up on the cliff a black hole. Believing it to be a cave, he at once determined to scale the cliff and several soldiers volunteered to accompany him. The ascent was exceedingly hazardcus and difficult, but after a long time they reached the hole. Jutting out from the face of the cliff was a natural shelf, about eight feet wide and twice as long.

"Just back of the ledge was the entrance to the ancient cave. Under the sergeant's leadership the party entered the cave with torches and lanterns. They explored a great number of rooms, passages and corridors. Many people had once inhabited the winding passages of the cave village, and many people had been buried in it.

"The soldiers penetrated into the furthermost reaches and found a big council chamber far back in the interior of the cliff. As the flickering light of the torches pierced the gloom of the large room a grewsome scene was revealed. Huddled together on the cold, damp floor of stone, as if for mutual protection, lay the ghastly skeletons of numerous little cliff dwellers, thoroughly desiccated by their exposure during ages past.[9]

"A short distance apart from the others lay the frame of the chieftain, leaning against the wall opposite the entrance to the room. His chin was resting, just as he had died. It seemed to the discoverers that he, perhaps, had died last of them all, and before his spirit fled had taken a final look at his people. Then his chin sank upon his breast and the people of White River Cliff were no more.

"Sargeant Price carefully removed the skull of the chieftain, and, by breaking a piece out of its side was able to take out the desiccated brain, which he most highly prized of all the curiosities which he collected in the region.[10]

9. One story related about the finding of these skeletons states that they were placed in a circle. It might be added that this room was probably a burial place and that the bodies were placed in the position found, when they interred them.

10. **THE APACHE MYTH ABOUT THIS CAVE**

Once, while in conversation with one of the medicine men the writer asked about this cave and also about the cliff house on Oak creek and in the Sierra Ancha region which will be mentioned later, saying: "Brother, you know of the cliff cave toward the mountains of snow. Also, when we were over toward Oak creek recently we saw many cliff houses. I would like to know who the people were who lived in these places and what became of them."

"It is a long story," he began. "It was a long, long time ago when these people lived here. They were a little folk. There were two tribes of them. One of them lived in the valley of the White Mountain creek, as one approaches the sun at his rising. They had a village in the valley; also a cave village. The other tribe lived in the Oak creek-Canyon creek cliff houses that you have seen and still farther on westward along the high escarpment of the Sierra Ancha. For many, many summers these people lived at peace and cultivated their little valley fields and hunted and killed the game in the forests and feasted with each other on special occasions.

Finally, after many years a White Mountain cliff dweller desired to take for his wife a daughter of the Oak creek chief; but her people would not permit her marriage. The White Mountain man, whose name was Elondazen, offered to buy his prospective wife; but after a great deal of negotiation, the Oak creek 'principals' rejected the proposed purchase, and Elondazen and his relatives returned home sad and dejected.

"Arriving at their home, a meeting of the 'principals' of the place was called; and, after considdrable consultation, it was decided to obtain the maiden, Gumwapa

No. MO. On a ledge on the west side of the North Fork about opposite Fort Apache hospital there is a small-house ruin, 59x22.

No. MP. A small ruin was seen in the valley about a mile above No. "A", the cave ruin.

No. MQ. Quite a ruin was seen on Little Bonito creek on the Bill Ryan ranch. It was not examined, as the writer was on official business for the agency when it was seen. On Ryan's other ranch about three miles north of Sharp's ranch there is another one.

(Salt) of the Oak creek people by stealth. So according to a prearranged plan, many White Mountain braves went and concealed themselves in the hills adjacent to Canyon and Oak creeks. It was the mescal gathering season. The women of the Oak creek village all went into the hills to collect mescal tubers. Gumwapa accompanied the other women. All were busy, when Gumwapa suddenly found herself being carried away in the arms of her lover Elondazen. She did not object much to going with him. And the women who were there tried not to help release her but all fled to the village.

"With pent-up fury, the Oak creek people pursued Elondazen and his warriors and the captured girl. They thought to rescue the latter, but were unsuccessful. Over the hills and through the timber and across canyons and creeks they chased the fleeing White Mountain people to their village home on White Mountain creek (White River), now a ruin up the east fork of White River some two or three miles east of Fort Apache. There in the valley a great battle was fought in which the Oak creek people were routed and driven from the valley to the region of Cedar creek and Sugar Loaf butte. Here night came on and the fighting ceased. Morning, however, brought a change of movement. In the night the Oak creek people had been reinforced by the Sierra Ancha cliff dwellers; and at daybreak, the combined forces fell upon the confident victors of the day before and put them to flight. Throughout that whole day then there was a running battle among the hills and ridges, dikes and buttes of the Kelley Butte country Even the coming of night did not cause the slaughter to cease. But under cover of darkness, the White Mountain people though hard pressed, were able to retreat up the valley to their village home. Here behind its walls they made a determined stand; but after a seven days' continual conflict, they were defeated again and a breach was made in the outer wall toward the rear of the village The night following, a pitched battle was fought in the plaza between the contending braves While the unequal contest was going on, the women fled with their belongings to the cliff cave; many had already gone there before the village was besieged. While the battle was being waged at its fiercest, Gumwapa was placed on the roof through a hatchway of one of the houses, by the enraged women of the place Her hands were tied. A lone woman appeared on the roof with her. This woman stabbed the helpless woman to death and then hurled her from the roof into the midst of her brothers and fellow countrymen, exclaiming as she did so: 'Take your sister Salt She has caused us trouble enough already.'

"The morning following found the village wholly in possession of the Oak creek braves; all the White Mountain people that had escaped death or capture had fled to the cave. But the people from the west were not yet satisfied They would yet have their revenge for the murder of Gumwapa So they pursued the fleeing enemy to their cave fort; and there at its entrance another pitched battle was fought for many days. Though the White Mountain people were defeated in this battle also, the contest was so near equal that the Oak creek braves could not force the entrance and capture the cave village. Having exhausted their strength, they retreated a safe distance from the cave entrance and there sat down to besiege the place till its inmates would be forced by starvation to surrender. For a long time they continued the siege but unsuccessfully. And worse still, each morning at sunrise the head chief of the cave people would come out on the little platform at the cave entrance and taunt the Oak creek enemy saying:

" 'Starve yourselves. Kill your own people since you wish to kill some one We are safe here. You cannot get into this cave. Our gods would strike you dead should you enter it. No, we will not surrender We have provisions enough stored within to last us many years, also a spring of fresh, clear water gushes forth in one of the rooms Go starve yourselves. If you wish to kill human beings, kill yourselves; then you will not offend any gods but your own.'

"The Oak creek people, however, would not give up the quest. They were bent upon having revenge. At last they called a meeting of their chief advisors; and, after many hours of deliberation, a new plan of procedure was decided upon.

CEDAR CREEK

No. K. Pueblo. On a bench seven miles southeast of No. 127, near the northwest base of Big Mountain, there is a small ruin, built of lava blocks. It was seen while hunting turkeys and was not measured. A large mortar, cup-like milling hole was seen on a lava boulder nearby.

No. KA. Pueblo. About ten miles nearly due south of No. "K", a small pueblo ruin stands on a high hill on the east side of Arrow Creek. It consists of two sections, as nearly as could be made out from its delapidated state. The main portion is nearly one hundred feet square, the other is L-shaped with 55 foot stone arms, 27 feet wide.

No. KB. Pueblo. One-half mile south of No. "KA" a small ruin lies on a hill on the east side of Arrow Creek. It is low and its outlines are now hard to make out. I would judge it was originally about 75x35.

Between this ruin and the junction of Cedar and Arrow creeks to the southward and in the vicinity of the junction of same several oval storage rooms were seen. The pottery seen here was redware, corrugated, and black-on-white.

Two small ruins wre also seen in the bottom lands about a mile from the above store rooms.

No. KC. **Pueblo.**—About three miles due south of No. "KB" on the west side of Cedar Creek, there is a semi-cliff house against the base of the cliff. It is small, showing the end walls of a single room, twelve feet in length, of which the front wall has fallen. It was probably a storage bin or a field shelter.

No. KD. Cliff Ruin. About a mile and a half below (south of) No. "KC" a small cliff ruin is located on the east side of Cedar Creek about two miles above the Arrow Creek junction. It consists of a single line of rooms built in a shallow cave, varying in width from eleven feet at one end to four at the other. The walls were of sandstone and still stand with rafters showing five or six feet above the floor. The walls were chinked (alternating coarse thick series alter-

"Under cover of the darkness that night they swarmed up over the ledge and captured the cave entrance, killing the pickets on guard in it or driving them back within the narrow hall-way. Then the assaulters brought up great quantties of resin and pitch wood and piled it high up about the hole in the cliff. Then they kindled a huge fire and never suffered it to abate its fury. For days and days they kept it burning; and the fire gleamed brightly by night and by day against the side of the vast rock face. A continuous, strong south wind also aided the assailants; the cliff (as we have seen) extends northward along a huge fissure (?) in the earth's crust, and the wind blew the choking smoke to the innermost recesses of the cavern. Death was certain to the imprisoned horde Hurriedly they collected in their inner chamber of worship and there perished while at prayer. At length the aveng.ng army retired, leaving a blackened hall-way and a giant pile of ashes on the ledge."

nating with a thinner series of rock) and plastered inside. The doors were still intact in doorways, with stone and stick lintels, each measuring about three feet by a foot and a half. Potsherds were very scarce about this site.

No. KF. Pueblo. Near the junction of Cedar Creek and Arrow (Middle Cedar) Creek about a mile below No. "KD" is a small ruin, 60x41. It seems to have been rebuilt by the Apaches.

No. KG. Pueblo. About a mile and three-quarters below No. "KF" on a mesa south of the junction of West Cedar Creek there is a pueblo ruin of more than one hundred feet square, though the buildings are somewhat L-shaped, the main portion being two or three stories high, and the wing one story. Pottery here was black and red-on-white, black-on-red, corrugated, and black-on-white.

No. KH. About two miles below No. "KG" there is a small ruin in the bottom land of Cedar Creek, opposite Sugar Loaf (Silver) butte. Considerable pottery is scattered about the site.

A small ruin with terraced slopes is situated on a small peak near the road three or four miles west of Cedar Creek crossing.

No. KI. Pueblo. About four miles east of Cedar Creek and two miles west of Saw Tooth, on the southern end of a three-cornered, sheer-walled mesa there is a ruin in triangular shape, 100 feet long with a base of 69 feet. The pottery here was much the same as that of No. "KG". No water was found in the vicinity of this ruin.

No. KJ. Pueblo. Two or three miles west of No. "KI", in a flat, there is a circular pueblo built of sandstone, 170 feet in diameter, two rooms wide on the north sector and three on the south, rooms placed radially. It was probably two stories high and its walls and heaps still are standing high. The court had some buildings in it also. There are also three smaller structures on a hillside a few rods west. One L-shaped, long arm 180x50 feet, short arm 75x14. The sherds of this ruin are much the same as those of Nos. "KG" and "KI".

There are many other ruins in the region but time would not permit the writer's visiting them.

CARRIZO CREEK

No. R. A considerable ruin lies in the bottom land near the junction of Deer Spring with the Carrizo about 20 miles due west of No. 128, and another, a mile above.

No. RA. There are several small ruins in the vicinity of Phoenix Park, situated on points of the mesa. Three were visited and more were reported as being in the vicinity. Similar ruins were also seen on points overlooking Buckskin Creek. Three here were examined. These ruins are all further up Carrizo than No. "R".

The Apache Altar at the top of the Carrizo-Cibicue divide on the Carrizo Trail

No. RB. About seven miles below No. "R" on the Carrizo, south of Blue Spring canyon, about twelve miles a little south of west of No. 128 there is a small ruin. Some excavation has been done about the site.

No. RC. Opposite No. "RB" on the other side of the creek there is an L-shaped ruin, main village 133x33, arm 86x34. And below it on the same side of the stream there is another small ruin.

No. RD. Some miles below No. "RC", on the east side of Carrizo, there is a considerable ruin. Sherds here are black-on-white, black-on-red, and corrugated.

No. RF. A D-shaped ruin, consisting of a rectangular portion 118x76 with a semicircular building in the rear, leaving a court some 70 feet across, is on a knoll on the east side of Carrizo creek, about two miles below its junction with Limestone creek. The semicircular part is practically level, twelve or fourteen feet wide, the buildings having been one story high. The rectangular section is pyramidal in appearance, though its rooms probably were not more than one story high. Also, on the point of the mesa behind this site there is a small ruin of seven or eight rooms. A small ruin, not far distant from this ruin, is now nearly obliterated.

No. RG. A ruin containing two sections, one 20 foot square and the other 42x26 lies on the south side of the Cibicue road about two miles west of Carrizo creek. Pottery is black-on-white and corrugated.

CIBICUE

No. 139. Ruins. Large ruins have been reported from Cibicue creek, a perennial stream flowing south from the "rim" and entering Salt River near the western boundary of the White Mountain Apache reservation. The valley of Cibicue affords excellent farming land, and the majority of the Apaches on the reservation live there. The ruins are about eighteen miles northwest of the post. They appear to resemble the ancient pueblo ruins at Forest Dale." (Hough, op. cit., 81).

The principal ruins at Cibicue are between two and three miles above the old battle ground where the soldiers were killed in 1881 and about the same distance above the present post office and Indian school. These ruins are composed of several groups and were built in a north and south row on the bench on the west side of the creek. Several of them are built in the form of a parallelogram with sides facing east and west. The buildings were built of local stone, mortared in with adobe. No estufas were seen. Six ruins are situated in this group.

These ruins differed from any the writer had seen, though the pottery seemed to be much the same as that seen at many of the other ruins of the region. One of the ruins (marked A-2) was apparently unfinished, for some of the walls are indicated only by a single line of boulders on which apparently nothing was ever built. There are also rooms with only three walls, the fourth wall missing. Another ruin about three-fourths mile above this, near the bank of Salt creek (marked A-1), and still another ruin nearby both have three-sided, unfinished rooms. The pottery about these sites is black-on-white and corrugated.

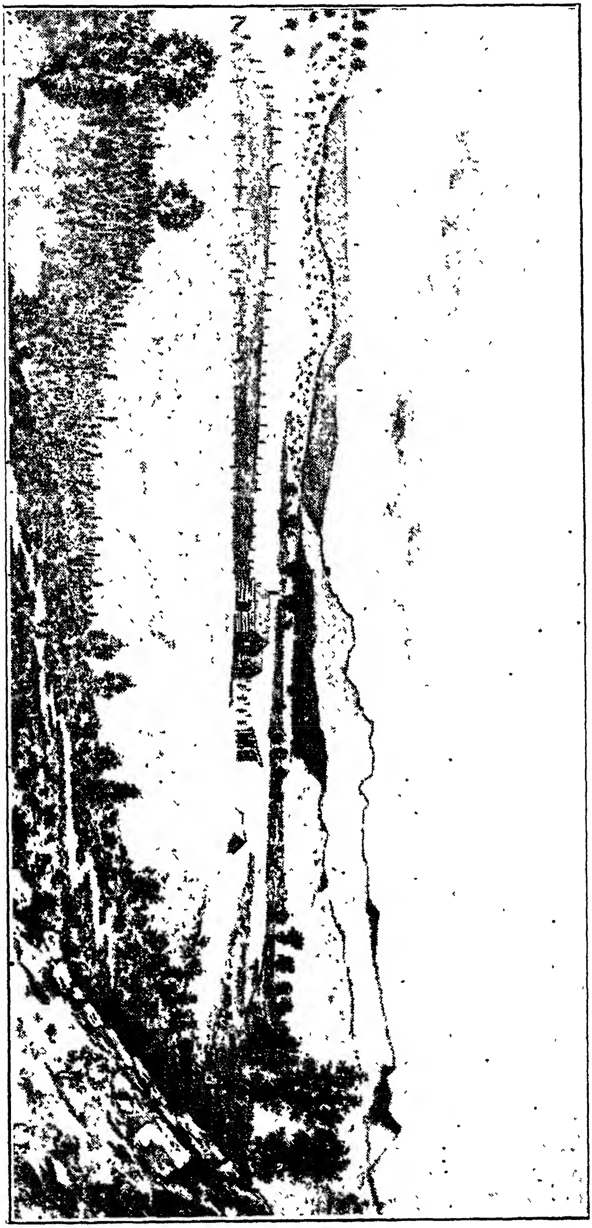
No. C. A small ruin on the point of a low mesa west of the creek, near the Government Day School.

No. CA. A ruin, 32x41, is on the east side of the creek opposite No. C, 200 yards above the school. Its pottery was like that of Nos. A-1 and A-2.

No. CB. A D-shaped pueblo ruin, 142 feet long at base and 143 feet transversely, stands in the bottom land near the creek, opposite the mission.

About a mile below the Cibicue post office the creek enters a canyon and continues more or less within canyon walls till it enters Salt River. It was reported to the writer that there are many cliff houses in this canyon, also many pictographs.

"To the west of San Carlos a high divide separates the waters of San Carlos creek from those of Pinal creek and other streams flowing into the middle Salt River near Tonto basin. There are numerous



The Cibicue Country

PINAL CREEK AND MIDDLE SALT RIVER DISTRICT

(Hough, op. cit., 82.)

ruins in this section cf Graham county east of the divide, but the only notice of them was by Bandelier, who visited this region in the early eighties. The following ruins, here numbered 140-146, were described by him:

" 'No. 140. **Pueblo.** North of Globe, on a steep, rocky projection, there is a small ruin, and one fallen beam of cedar remains in the house. The pottery is corrugated and very coarse.' (Bandelier, Final Report, pt. 2,415).

" ' No. 141. **Ruins.** South of Globe, on a denuded promontory, is a large ruin of the checkerboard type. The ruin has no central mound, but-------- the small buildings and connecting inclosures are numercus and well preserved. The walls were of stone, and none of the buildings seemed to have been higher than one story. No traces of estufas were visible.' (Bandelier, op. cit., 415)." (Hough, op. cit., 82).

"No. 142 At Gibson's ranch on Aliso creek, twelve miles southeast of Globe are several small ruins, one of which has seventeen compartments. It has been supplied with ditches like those of the ruins south of Fort Thomas." (Hough, op. cit., 82).

"No. 143. An important ruin stands on the north side of Salt River near the ranch and home of Mr. Armer. It is characterized by a long mound that forms part of the open polygon of the ruin. The mound is eleven feet high and contains rooms. Here we found several pieces of hammered copper and a copper rattle. (Bandelier, op. cit., 431.)" (Hough, op. cit., 82).

"No. 144. Five or more ruins are found near Kenton's ranch on the south side of Salt River along a stretch of eight miles; they are like the ruins at Globe (Bandelier, op. cit., 419-420). Another ruin said to contain 138 divisions (house inclosures), was seen by Mr. Bandelier. It is seven miles from Globe and four miles below Wheatfields (Los Trigos)." (Hough, op. cit., 82).

"No. 145. On Pinal creek, two miles north of Livingstone and two miles below Wheatfields, are two small ruins on steep promontories. One of these seems to have been surrounded by a wall. (Bandelier, op. cit., 418)." (Hough, op. cit., 82).

"No. 146. About seven miles north of Linvingstone and a short distance west of Cherry creek are two small ruins of the checkerboard type, made up of mounds and quadrangles. (Bandelier, op. cit., 417)." (Hough, op. cit., 82).

"Many cliff-ruins and cave dwellings are said to exist in the gorge of Salt River, near the mouth of Pinal creek, and in the Sierra Ancha,

north of Salt River, many ruins are reported. (Bandelier op. cit., 417-418)." (Hough, op. cit., 82).

ADDITIONAL RUINS SEEN BY THE WRITER

Nos. A-1 and A-2. These are ruins on Cibicue creek and have been included under No. 139.

No. A-3. Pueblo. This ruin is situated about a mile west of Grasshopper springs on a limestone flat west of Little Cibicue creek some ten miles west of the Cibicue Indian school and post office. The village was rather large and extends in an east and west direction and is so placed as to form a dam across a small stream that flows southwestward to Salt River; undoubtedly the water for village use was impounded by the village being built across this stream. The only water near it at all comes from the Grasshopper springs which are mere seeps at present and which flow down a canyon eastward, directly away from the village. The village shows every evidence of there having been a large cleared area around it which must have been irragated from the reservoir in its rear. That these people were agriculturists is also further attested by the ancient irrigating ditch which leads eastward down the north side of the valley of Little Cibicue from the springs for over a mile to a widening vale which undoubtedly was their field. The ditch is high and in some places has been cut out of the solid rock. Farther down the valley in about the then fields are houses built of travertine deposits which must have served as summer lodges. The irrigating ditch also indicates that there was more moisture in the region formerly than now, as there is not enough water flowing from the springs now to run down an irrigating ditch that far. The village west of the springs must have contained several hundred inhabitants and must have been inhabited for a long period of time, as is attested by the extensive graveyard east of it, whose surface is chalky with bones.

No. A-4. Blue-House-Mountain Pueblo. While riding through the woods two or three miles south of Grasshopper springs the writer came upon a large walled village on Blue-House Mountain, covering a hilltop, all in ruins, the encircling wall forming a terrace. The walls were erected almost in the form of a square, arranged according to the cardinal points and were ten or more feet thick; they are now five or six feet high. The village is a huge pile in L-shape and is now about fifteen feet high in its center. It shows extreme age, one room having a large tree growing in it. The whole structure was of rock. The whole village was surrounded by forest and there are no signs, so far as the writer could see, of any land having been tilled near it. Furthermore, the only water in the vicinity was a small spring about a half a mile down the canyon to the east of it. About 300 people must have lived in this village.

No. S. Brush-Mountain Ruin. There is quite a ruin in the vicinity of Brush mountain, south of Blue-House mountain. It was seen while on a trip to Salt River, but as the trip was a hurried one, it was not examined.

No. A-5. Pueblo. The post office at Ellison is located in a large Quaternary flat east of the Catholic buttes about a mile south of Juniper butte. Evidently there has been a small lake bed there. The deposits, which cover about three-fourths of a township and are quite thick, are surrounded by Cambrian and older pre-Cambrian rocks. The deposit is black and very fertile when irrigated. Newton creek flows through this flat and joins Canyon creek in the vicinity of John Dazen's camp. Across this stream, just west of the Ellison post office, a massive village was so built as to serve as a dam to the stream, a home for its people, and a fortification in the case of an attack. The village was built of stone which ws transported half a mile to a mile. It was built in a north and south trend, the larger part being north of the stream. It is the most extensive ruin seen by the writer in that part of the southwest, and must have contained 1000 to 2000 inhabitants. It was evidently destroyed long ages ago, as it is now a giant pile with trees growing on parts of it. Private individuals have done some excavating in it and have found much pottery, arrow heads, and some "images", such as stone and burned clay ducks, birds, and animals, also what appear to be children's playthings.

These people not only irrigated the floor of the valley in which the village was situated, but appear to have extended their irrigating ditch eastward down the valley to other lands.

Large ruins were also reported in the upper Cherry creek valley in the vicinity of Young, west of Ellison; and also on Bonito creek southeast of Fort Apache, above the sites visited by the writer.

No. B. Cave. About due east of ruin No. 129 on the east side of White River a small cave extends eastward beneath the Red Wall escarpment that closes in the valley. The writer started to examine it but was met by yellow jackets, hornets and rattlesnakes in vigorout protest, so he does not know its extent. Its entrance is smoked, indicating that it had been inhabited.

No. C. While the writer was putting in the irrigating ditch on the east side of White River below Fort Apache in the spring of 1902, the workers dug through an old ruin and graveyard, both of which were being covered up by the slipping hillsides. The graveyard, which is extensive, was the more interesting. In places it appeared that one person had been buried above another; the interment had been so long

ago that only traces of the bones could be found. The men apparently had had their war and hunting accouterments buried with them; the women their culinary things such as grinding slabs, obsidian "toothed combs", skin scrapers, obidian "saws", vases and pots, also drills, cloud blowers (found also in the graves of the men), pipes, a bowl cut out of vesicular basalt and so carved as to represent a turtle, carved stone birds, a stone lizard, and shell beads. The workers claimed the curios and sold them at one of the stores at the post.

No. C-1. Cave. About a mile north of Whiteriver post office is a small cave in the basaltic canyon wall west of White River. It is probably thirty or forty feet long and fourteen feet wide at the widest place and is inclosed in basaltic walls. Much debris covers the floor. In 1901 a curio collector took a thirty-gallon storage earthen jar out of this cave and also a pair of rabbit skin woven sandals.

No. D. Pueblo. Just before entering Cedar creek canyon on the trail leading westward from Fort Apache to Cibicue a small dry creek is encountered entering Cedar creek from the east. Just as one reaches the brink of this dry canyon he is struck by the pile of village debris on a little rock ridge in the center of the dry canyon. The pile of heterogeneously tumbled rocks is what is left of a large village which once occupied the site. The village was built in an east and west trend and covers the whole inner-canyon ridge. The rock of which the village was built was obtained locally. One would think that the village was built on this ridge for protection if it were not for the fact that it is so near the south canyon wall of the creek that a good bowman could have commanded the village from the adjacent mesa. Again, the village might have extended to the canyon walls and formed a dam for the stream, as is the case of the village at Grasshopper springs. The village is being carried away by the encroaching stream. Even without damming this dry creek, the village had water in abundance for all purposes except irrigation in springs on Cedar Creek about a quarter of a mile distant at the place where the Cibicue-Fort Apache trail crosses the creek. But for adjacent land to irrigate and on which to raise crops, they might be said to be nil, unless the villagers were able to obtain water from some source (possibly from Forest Dale creek) to irrigate the now dry flats north and east of the village. It is quite possible that they used storage reservoirs to furnish water for their crops. The principal curios that have been obtained from this ruin are obsidian arrow heads, which are very numerous.

No. ID. This is a cliff house on Cedar creek some miles above the last named village.

No. E. Pueblo. While on a trip to salt River the writer passed a pueblo ruin, but there was not time to examine it, further than to notice that it was of stone.

This is a view of a cliff house on Cedar creek, by Dr. Goddard of N. Y.

No. V. Fortifications. There are rather extensive fortifications on Sugar Loaf (Silver) butte.

No. F. Pueblo. On the high mesa between Canyon creek and Cherry creek the writer passed a pueblo ruin on the margin of a little canyon that leads eastward to Canyon creek. Time would not permit examining the village. This village had had sufficient water from dripping springs in the Dripping Springs quartzite of the walls of the canyon. There were also indications that there had been considerable cleared land under cultivation; the crops were probably raised without irrigation as the mesa is high and well wooded and receives considerable rain in summer.

No. Z. This is a ruin of a cliff house on Grasshopper creek two miles above Salt River.

No. GK. Ruins. These are the ruins and cliff house on the Elsesa travertine deposits between the sawmill and the post. They have been described under No. 130.

No. G. Cliff Houses. In a little side canyon north of the Cibicue-Oak creek trail in the broken region about three miles east of Oak creek crossing are several cliff houses under a projecting ledge. Three of the houses are still intact, even the roof is intact and entire on two of the apartments. There had been other rooms in front of these but as they were exposed, time and weather have removed them. Some stone was used in the building, but most of the walls were of adobe. The roof was placed on cedar beams placed about a foot apart. These were overlaid with small poles on which limbs and

This is a second view of the same cliff house as the preceding, also made by Dr. Goddard of New York

yucca leaves were placed, and over these adobe mortar had been placed to the thickness of about ten inches. This mortar is now apparently as hard as our ordinary lime mortar. The fire in the rooms was built directly under a square hole in the roof some two feet in diameter through which the smoke escaped. Some of the rooms had doors through the walls; others only through the roof. The doors were very small and low. The floors had been leveled with adobe mortar. Back of the rooms were bins. In these the writer found a kind of grain, somewhat resembling barley heads, also corn on the cob, but when touched the grains fell to powder. The grain had been gathered in the head and was evidently shelled out by a hand rubbing process when needed. Among the corn ears and cobs was found a beautiful vase-jug with drawing of the sun surrounding the opening. It was about a gallon size and was evidently a plaything for some child or was a vase in which to keep sacred things.

The bins must have contained forty-five bushels of corn and much grain when the people of the village abandoned it. This, it seems, is conclusive evidence that these people left their village in haste, fearing an attack by some other tribe.

It is quite probable that not more than sixty people ever lived in this village. Their crops evidently were all raised in the canyon valley in which the village is situated. Most of the valley is above (east of) the village. There are some indications of terracing at several places and also what seem to be the remains of an old ditch is also noticeable at a few places. There appears to be water in

springs about a half mile above the village to insure a supply for village use.

No. H. Cliff Ruins. There are several cliff houses along the east front of the Sierra Ancha high up above the valley floor, but opportunity never permitted the writer to visit them.

No. S-1. Ruins. Several ruins were seen in the Chiddessky region of upper Canyon creek, but there was never time to examine them.

A CONCLUDING REMARK

The pottery of the White Mountain area is distinctively Zunian, but that of the western and southern sections varies somewhat from it. The pottery of the latter shades toward the pottery of the Gila group and that of the former toward that of the Verde area to the westward. The White Mountain pottery seems to somewhat fit in with that of the middle prehistoric period of the Zuni people as represented in the Zuni valley and environs; and, again, some of its characteristics would seem to place it as the "parent" of the pottery of that valley, but more data must be obtained before its exact position can be definitely determined.

ANIMAL LIFE IN SYNTHETIC MIXTURES OF NITROGEN AND OXYGEN

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In previous papers[1] of the Academy it was shown that animals cannot live in an atmosphere of pure oxygen under control, nor in an atmosphere which contained twenty-one per cent of oxygen and seventy-nine per cent of nitrogen by volume leaving out the rare gases. This was most surprising.

It was also shown that in the same percentage mixture of argon and oxygen that the white mice could not live, but by using seventy-five per cent argon and twenty-five per cent oxygen, the mixture supported normal life, if not better than normal. With these last two synthetic atmospheres the animals not only survived but appeared to be stimulated and benefited by breathing it for a period of ten days or longer.

In a series of thirty experiments it was found that small animals such as mice, pigeons, guinea pigs, cats, monkeys, etc., can live in a medium of air under control, but in pure oxygen under the same conditions they will die within from two to six days. In only one case did any of the animals live over a week in pure medical oxygen—the snake lived four weeks.

By decreasing oxygen to ninety per cent with ten per cent nitrogen they would die in seven days. In an atmosphere of eighty per cent oxygen and twenty per cent nitrogen they would die in nine days. By making a mixture of oxygen seventy per cent and nitrogen thirty per cent, they seemed abnormal after being in this atmosphere for about a week. The experiments were continued with mixtures of synthetic atmospheres as follows: oxygen sixty per cent and nitrogen forty per cent; oxygen fifty per cent and nitrogen fifty per cent; oxygen forty per cent and nitrogen sixty per cent; oxygen thirty per cent and nitrogen seventy per cent; oxygen twenty-five per cent and nitrogen seventy-five per cent.

By varying the per cent of oxygen from twenty-five per cent to sixty per cent the animals were under control from ten days to three weeks without any signs of ailments. From these experiments we find that there is an ascension and decension in curves in plotting the per cent of oxygen with the time that they could live. (Figures 1 and 2.)

1. Hershey, J. Willard. A study of the components of air in relation to animal life. Kansas Acad. of Science, 31; 101-102, 1928.

Hershey, J. Willard.. Physiological Effects of Oxygen Atmospheres Diluted by Nitrogen. Trans. Acad. of Science, 32; 51-52, 1929.

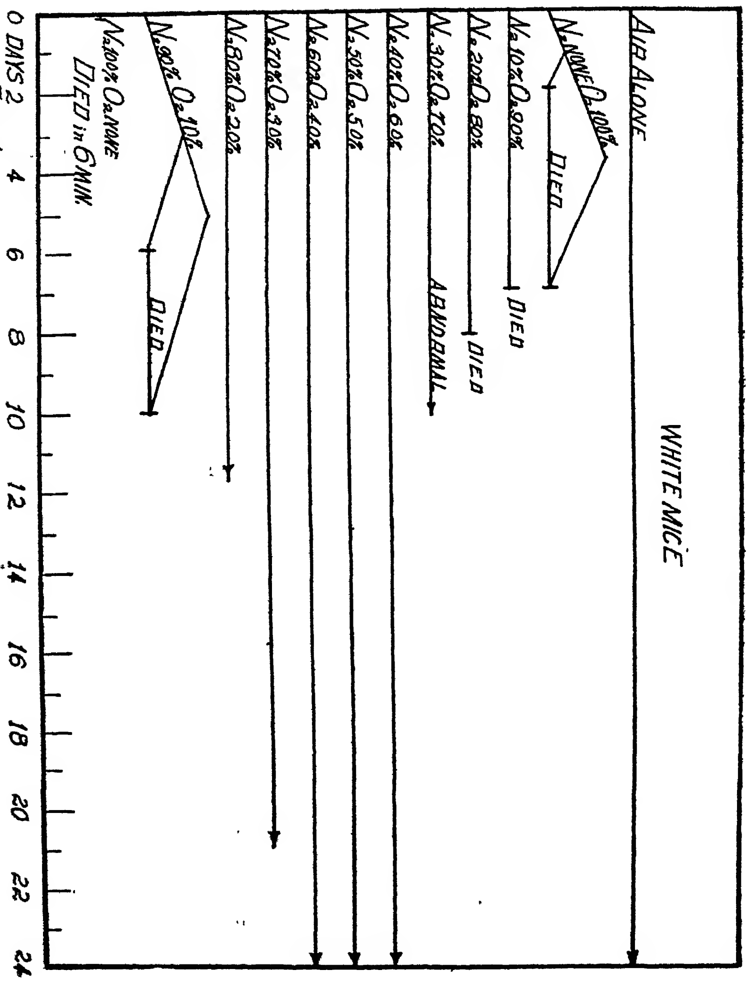
WHITE MICE
AIR ALONE
N2 NONE O2 100%
DIED
N2 10% O2 90%
DIED
N2 20% O2 80%
DIED
N2 30% O2 70%
ABNORMAL
N2 40% O2 60%
N2 50% O2 50%
N2 60% O2 40%
N2 70% O2 30%
N2 80% O2 20%
N2 90% O2 10%
DIED
N2 100% O2 NONE
DIED in 6 MIN.
0 DAYS 2
4
6
8
10
12
14
16
18
20
22
24

FIG. 1.

In a number of cases it was found that artificial atmospheres could be prepared that supported life in white mice more effectively than the normal air that we breathe every day.

This is really only one phase of the work that might be investigated. It would be desirable to have some other criteria than life as a test—for example: rate of growth, metabolism, activity, why they die in oxygen, etc.

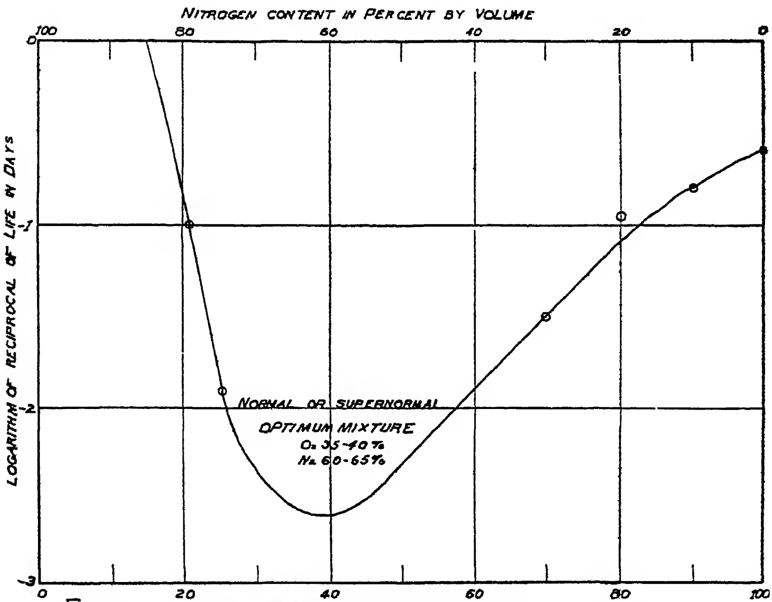

FIG. 2

Not only may synthetic atmospheres be used by divers and caisson workers, aeronauts, etc., but the widest field probably will be in the pathological application.

Figure 1. This diagram shows the relationships between varying combinations of nitrogen and oxygen in a synthetic atmosphere and the life of white mice. The end of the arrows show the number of days that the experiments were run.

Figure 2. This figure is a plot of the logarithm of reciprocal life in days of white mice as a function of nitrogen and oxygen in a synthetic atmosphere.

CACAO BEAN AND ELIMINATION

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The Cacao Bean has been used for several centuries, mostly as a beverage. Eden in his Decades of the West Indies published in 1555 mentions it;[1] and D'Acosta in his History of the Indies[2] referred to it as "a drink which they call chocolate". It seems to antedate coffee which is first mentioned in 1598. The Cacao plant was listed by Linneaus in 1737. Its use was mentioned in the United States in 1760.

Owing to the pleasing taste of the roasted bean, it quickly came into popular favor wherever introduced; so at the present time enormous quantities are imported into Europe and the United States. For a long time it has been known that the Cacao bean contained from 1.2 to 1.5%[3] Theobromine, an alkaloid similar in its properties to Caffeine. Reference is made to the effect of the alkaloid on the human organism and also the food value of chocolate and cocoa has received attention. But there is little mention of the physiological effects of the ingestion of the bean other than general statements in regard to its effect upon elimination and the suggestioon that catarrhal conditions are unfavorable influenced by its use.

It is probably due to the influence of chocolate upon the mucuous membrane that severe attacks of colitis are experienced when it is taken in doses of fifteen to twenty grams for two or three consecutive days. Further investigation is contemplated to determine the influence on elimination.

1. p. 342.
2. IV, XXII, 271.
3. A. J.. Pharm. 1862, p. 509.

TWO "HERDS" OF THREE-TOED HORSES

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"Of all the fossils of the great western Tertiary Badlands perhaps none have elicited more genuine interest than those of the Equidae, or horse family.------No other mammal displays such a lengthy, well connected lineage, nor discloses a more beautiful handiwork in the well-ordered development of structure and habits. For perhaps several million years, members of the family have roamed the hills and dales of the earth, molding their nature to an ever changing environment, discarding many things inherited from their evident Cretaceous five-toed progenitors, and taking on new features leading to the exquisite relation of organs and actions in the finely built horse of today.[1]"

From five toes to one toe has been an interesting story, not that five toes to one toe is anything to marvel about, but because of the fact that five toes were once an absolute necessity. Both five-toed and three-toed horses, in their times, had problems to solve. One of the problems they had to solve was the conflict with large Carnivores, such as hyaenodonts, dogs, and saber-toothed cats. They solved this problem by running. To escape they must move rapidly, therefore, speed was at a premium, and higher and higher they ran on those middle toes to gain more speed. Plant life of lake, marsh or stream may be eaten by animals with so-called browsing teeth. Plains grasses need grazing teeth. The horses solved another problem when they changed from browsing to grazing teeth.

It is to the saber-toothed cats and other carnivores of Eocene and Oligocene times that we owe the one-toed and speedy horses with grazing teeth, the results of being driven from marsh and dense thickets to open prairie and plain. The carnivores had practically determined the direction of horse evolution by the close of the Oligocene, and in the Miocene we see the last futile attempt of the browsers to maintain themselves.

Problem solving has been going on since time began, and it is an extremely interesting fact, that what ever peculiar anatomical structures an animal may possess, or whatever its adaptations may be, those very items tell just how well that group of animals solved its problems.

During the collecting season of 1927, Mr. Geo. F. Sternberg, Mr. Edwin Cooke and the writer were engaged in collecting fossils from the Oligocene and Miocene of east central Wyoming. The territory covered in these Badlands was about 8 miles wide by 14 miles long, starting from a point about 31 miles north and east of Lusk, Wyoming and extending toward Harrison, Nebraska.

The so-called Badlands are here located on the north and east slope of Pine Ridge and the drainage is north and east. The ridge itself is mostly Miocene and by working down the slope to the north and east the following formations will be observed: 1. Upper Miocene. 2. Middle Miocene, 3. Lower Miocene, 4. Upper Oligocene?, 5. Middle Oligocene, 6. Lower Oligocene, 7. Upper Cretaceous. In some localities a division may be entirely wanting, while in others it may be very thin or covered. This irregularity and unconformity may be easily understood if one realizes that deposition and erosion are continually in conflict with each other.

This season's collecting was confined largely to the Titanotherium beds of the lower Oligocene, the lower and middle Oreodon beds of the middle Oligocene, and a short time in the lower Miocene along Pine Ridge. The horse material in this locality proved to be very scarce indeed. In fact, we secured only a few fragmentary jaws and teeth in these Oligocene beds. We moved up along Pine Ridge for a little prospecting and worked around the north face of the capping escarpment which was here lower Miocene.

On a rather flat slope perhaps 75 feet below the top of the ridge, we came upon an area nearly 100 feet wide by 300 feet long which had been subjected to considerable wind and water erosion. The result was that here the soft whitish sandstone was eroded into numerous sugar loaves, mushroom rocks, and flatirons, making an ideal place to look for fossils because the edges of these mounds make a fine surface for the exposure of fossil bones. Around the edge of one of these mounds I located several ribs in a series, thus indicating at least part of a skeleton imbedded in this fine sandstone matrix.

We carefully uncovered the head, the vertebral column, both hind limbs, and at lease one complete forelimb. The skeleton was then prepared for incasing in a plaster cast. The matrix was removed from the upper half of nearly all the limb bones, the ribs and vertebrae were carefully traced, and the skull and lower jaws were partly worked out. A thin coat of dissolved gum Arabic was then aplied to all exposed bones and, when this had dried, the entire specimen was covered with moistened tissue paper, and a plaster cast was put on the slab. When the plaster had "set", the slab was undermined, turned over, trimmed down and the bottom side was covered with plaster, thus placing the entire section into a solid burlap and plaster cast. It could now be handled and shipped without danger of breaking the very fragile bones. The size of the section as removed from the matrix was approximately 14 inches wide, 48 inches long and 6 inchs thick, and contained the nearly complete skeleton of a little three-toed horse of the lower Miocene. This specimen probably belongs to the genus Parahippus.

"Parahippus represents one of the last efforts of the so-called browsing horses. In these browsing forms the teeth were all low crowned and early formed their roots, and the crowns were either without cement or with merely a thin film of it in the depressions of the grinding surface. The pattern of the grinding surface is so very much simpler than in the high crowned prismatic teeth of the grazers that it requires close analysis to detect the fundamental identity of plan. Such teeth imply that their possessors must have fed habitually upon a softer and less abrasive diet than grass, probably the leaves and soft shoots of trees and bushes and other succulent vegetable substances, very much in the fashion of existing deer, and must therefore have been chiefly inhabitants of the woods and groves and thickets along streams, as the grazing species were inhabitants of the plains and open spaces."[2]

During the collecting season of 1928, the territory covered was a rectangular strip about 5 miles wide by 10 miles long, beginning at a point some 14 miles northwest of Crawford, Nebr., and extending in a northwesterly direction. Again the work was largely in the lower Oligocene, with an occasional trip into middle and upper Oligocene.

Here a fine cross section of the Oligocene deposits may be observed. Beginning on the southwest with the Pine Ridge of Miocene age, which rest on the Oligocene, we have sloping toward the northeast, the eroded Badlands of the Oligocene which continue to the contact with the Pierre shales of Cretaceous age. The drop here is several hundred feet, resulting in marvelously eroded Badlands in the Oligocene deposits.

The Oligocene deposits here are quite varied, grading from very fine clay through fine sandstone to some very coarse gravel beds of channel deposits, and with an occasional mixture of volcanic ash. The nature of the deposits indicate broad flood plains and valleys, probably bordered with a dense growth of trees and shrubs. Then there were arid plains, with meandering streams which at certain seasons of flood time carried much silt and clay, while at other times they followed very definite channels and dropped down their load of gravel and sand.

with such conditions a varied flora and fauna would be expected. It would vary from aquatic or marsh to jungle, and from flood plain and forest to prairie or a semi-desert. True to the nature of the sediments we found in these deposits the bulky Titanotheres and aquatic rhinoceras types frequenting the marshes, with also an occasional crocodile. There were also, unquestionably, wading and swimming birds, for the writer has collected several fossil eggs from these deposits, although bird skeletons are as yet practically unknown. The forests which bordered the marshes were inhabited by the carnivores, hyaenodonts, dogs, and cats, the giant pigs, (Elo-

theres) and a great number of Oreodonts. Skirting the edge of the forest, held at bay by the carnivores, we find the running rhinoceras types, the little horses, camels and deer.

We were still on the trail of the ancient horses, and although we secured no complete skeletons, we were able to collect two complete skulls and lower jaws and many fragments of jaws, teeth, and some limb bones. We seemed here to have gotten into some Oligocene deposits that carried an abundance of fossils of many species of carnivores, turtles, oreodonts and other vertebrate types.

Near the latter part of July of the 1929 collecting season, we returned to this same locality. The party included only Mr. Geo. F. Sternberg and the writer. The previous year's work had made it possible for us to acquaint ourselves with the various gradations in the beds. We had located the fossil bearing horizons and established some fairly accurate contact lines. We wasted no time in prospecting in the barren layers which yield nothing. This fact is of as much importance to the fossil hunter as to the oil geologist, because each must select the type of sediment which tends to be best suited to his purpose.

We had not been in the field long before we began finding horse material (Mesohippus bairdi). The first date record in our field book is July 24th and the last date is Sept. 2nd. During that time we listed 25 numbers of horse specimens, besides many odd limb and foot bones, and fragmentary jaws. The number of skeletons found was materially increased by the lucky discovery of two quarries. From quarry No. 1, which was discovered by the writer, we were fortunate in securing 8 specimens, and from quarry No. 2, which was discovered by Mr. Sternberg, we were able to take 6 specimens. From quarry No. 1 we listed 6 specimens as skeletons and from quarry No. 2 we listed 4 skeleton numbers. That is, from the 14 specimens collected from these two quarries we were able to list 10 numbers of specimens as skeletons, each having the skull and lower jaws present, along with nearly all limb and toe bones and a vertebral column. This we believe to be the largest number of articulated three-toed horse skeletons ever collected from one locality, and probably the quarry with the eight specimens was the first discovery of its kind in the Oligocene beds. Quarry No. 2 with the six specimens was found only a few hundred feet from quarry No. 1.

The major purpose of this paper is to give some idea of the locality and horizon from which these specimens came, the arrangement of the specimens as they were taken from the quarries, and finally an interpretation of the deposition and erosional phenomena associated with the occurence of this group of articulated horse skeletons.

This particular locality seems to be a rather isolated section of Bad Lands, with only a few miles of exposure. They nestle under the very rim of the overlying Miocene deposits and the exposures are extremely steep. Many of the cliffs are nearly vertical, making prospecting extremely difficult. One feature leading to the formation of these precipitous exposures is the occurence of concretionary nodular bands which extend over a wide area in the Oligocene beds. The softer clays are easily eroded from above and between these concretionary bands, and as a result a clean swept floor of a few feet in width occurs which ends at the edge of a concretionary layer, and an almost vertical cliff leads down to the next concretionary band. This gives the deposits considerable of a terracing effect with extremely steep slopes and very narrow erosional floors or shelves.

The exact location of these quarries is approximately ten feet below the uppermost red band, which here occurs about midway in the series known as the lower nodular layer of the Oreodon beds, and may easily be correlated with the Oreodon-Culbertsoni-Mesohippis bairdi zone and also the Red Layer. When the first quarry was discovered, three skeletons were observed, small parts having been exposed by a narrow ravine which had evidently just touched the edge of the quarry.

The length of the quarry seemed to be about 18 feet and the bone bearing layer never more than 2 feet wide with the depth of the bone bearing layer approximately 6 inches at the deepest point. Four of the specimens face west, 3 lying on the left side and one on the right. Four specimens face east, 2 lying on the right side and 2 on the left. All specimens facing west have the skulls in place, while two of the specimens facing east have their skulls missing, probably washed away by the ravine that had exposed the quarry. Both young and old individuals were here grouped together, at least two were very young, because the distal and approximal ends of the limb bones had not yet grown solid. Two others seem to be quite old, for their teeth were worn down extremely low.

Quarry No. 2 which was found only about 1000 feet to the west and north of quarry No. 1 appears to be exactly in the same horizon, being about ten feet below the uppermost red band which here occurs midway in the series known as the lower nodular layer of the Oreodon beds. It was exposed in a narrow ravine near the rim of the flat prairie tableland. The ravine seemed to have cut almost parallel with the quarry which was again long but narrow. This quarry was about 15 feet long, about 3 feet wide at the most, and the bone bearing layer about 8 inches deep where the three skeletons were clustered together. Two specimens lie on the right side and face east,

two on the left side and face west, and two on the right side and face north.

The final point deals with an interpretation of the erosional and depositional phenomena as regards this group of associated Mesohippus skeletons of the Lower Oligocene.

In the first place a brief word about the origin of the Oligocene deposits. The Oligocene is now considered as a fluvatile or flood plain deposit and little thought is given to the old theory of lacustrine or lake deposit. The clays and sandstones have been derived largely from the Black Hills uplift which is to the north and west of the Oligocene deposits, and were laid down by streams which carried an abundance of sediment from the Black Hills out over these flat plains. Intermittent seasons of great rainfall and periods of aridity or drought have given rise to many interesting features in these beds, one of which seems of paramount interest in connection with the occurence of the horse quarries. This item is the occurence of the lower nodular layer in the Oreodon beds.

The formation of these nodular bands which indicate extreme periods of aridity[3], are of great importance in their effect on the fauna, and no doubt were closely tied up with the assembiying together of these two herds of little three-toed horses of Oligocene time.

Based on three seasons collecting in these beds the following picture is the writers interpretation of conditions in this locality at the time these little horses were buried.

There must have been several long periods of extreme floods, which had deposited the clays of the lower Oreodon beds, building up perhaps a hundred feet of clays, with an occasional nodular band. The last of a series of floods seemed to terminate in a long period of great aridity in which a wide nodular band was developed. This band of nodules evidently represents a great flat plain, with a few large lowbanked, meandering streams, which can now be traced for miles by the channel sandstone deposits. Both of the horse quarries seem to have a very close connection with one of the large flat streams which had cut its bed down only a few feet below the nodular band, its probable starting place.

Both quarries are located just at the south edge of the channel sandstone layer, and only about a quarter of a mile apart. The sandstone layer thins out toward the edges of the stream, being only a few inches thick near the quarries, but becoming several feet thick near the center of the deposit. Near the edge of this large stream there were probably small ravines or gulches which had been cut back into soft clays. A heavy rain would quickly cut them out, leaving steep banks and a soft muddy bed. The ravines were no doubt

quite narrow, being only two to five feet wide, and extending only a few yards back from the main channel.

It seems that both of these quarries were deposited in just such a manner. Both are on the edge of the channel sandstone layer, both quarries are long and narrow, and the specimens seemed to be confined to a narrow passage way, evidently between two rather high steep banks. The wonderful preservation of the feet, nearly all being complete and articulated, would tend to prove the specimens walkd or perhaps fell into this narrow ravine and were quickly caught by a flood or mired in the soft clay in the bed of the gulch. It is quite evident that they were quickly covered, because of the remarkable series of complete and articulated specimens. Had they been exposed long, it is quite probable some carnivore would have found them and scattered them all about the ravine.

It is doubtful if they could have been caught by a flood and floated into such a place and then dropped down by a whirl pool or backwater eddy. If such were the case, the skulls would evidently be lower than the bodies, because the gases in the body would tend to cause the feet to trail and be above the head. This does not seem to be the case, for the head is usually above the body and the feet below the vertebral column and ribs.

Just how and why they were trapped is a problem on which opinions will differ. Possibly a saber-toothed cat drove them in from the plains and crowded them over the edge and they fell into the mire below, the stream preventing their escaping that way. Possibly they had descended from the plain to the stream to get water and had attempted to return to the prairie table land by following up the narrow ravine, only to become mired or trapped in some way.

To the writer it is an interesting story, and he feels that he was indeed fortunate in the discovery of quarry No. 1. This collection of eight little fossil horses is now in the possession of the National Museum at Washington, D. C. Quarry No. 2, which was discovered by Mr. Geo. F. Sternberg, yielded six fossil horses, which are now in the possession of the California Institute of Technology, at Pasedena, California.

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THE SCIENTIFIC VALUE OF CARBONIC ACID

LYMAN C. WOOSTER
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There are two acids with which the geologist must become acquainted before he can understand the main chemical activities in the crust of the earth. These are conbonic acid and silicic acid. Carbonic acid is active in the colder, outer parts of the earth and silicic acid prevails in the deeper, hotter parts of the earth. The most effective work of the carbonic acid is done on the limestones and the feldspars of granite and gabbre.

Limestone is chiefly calcium carbonate and this is essentially insoluable in pure water. But limestone may take a second portion of carbonic acid and then the stone is soluble as salt.

Carbonic acid is soluble in rainwater and is abundant, hence rainwater dissolves limestone and becomes "hard". So the limestones are slowly disappearing and the rivers are running "hard" waters.

When the teakettle is filled with "hard" water and placed over a fire, the heat drives off the second part of carbonic acid with the water vapor and clinker (limestone) accumulates in the bottom of the teakettle.

Clams can drive out half of the acid and use the calcium carbonate for their shells. Softwater rivers have in them no clams. Coral reefs could not be formed except in water containing calcium bicarbonate, the coral polyp thus softens the ocean water.

When water containing calcium bicarbonate evaporates, half of the acid goes off with the water vapor and the calcium carbonate is precipitated and collects on any nearby object making tufa, stalactites, stalagmites or oolite (on grains of sand).

These properties of carbonic acid when dissolved in rainwater give easy explanations of the formation of caves with their stalactites and stalagmites and the troubles which follow the use of "hard" water in engine boilers.

The feldspar of granite is made up of the metals potassium and aluminum held by silicic acid. Carbonic acid of rainwater slowly removes the potassium making potassium carbonate, an alkali, and leaves aluminum silicate or kaolin, the chief ingredient of clay and shale. The alkali may remain in the clay or shale to the injury of crops if too abundant. Usually, however, it is acted upon by the nitric acid of rainwater making potassium nitrate, a valuable fertilizer known as saltpeter.

The feldspars of lava, basalt and gabbro are collectively made up of the metals aluminum, sodium and calcium held by silicic acid. The carbonic acid of rainwater removes the sodium making sodium carbonate and the calcium making calcium bicarbonate. The sodium carbonate is a strong alkali, but it may be neutralized by the nitric acid of rainwater making sodium nitrate or Chili saltpeter, a valuable fertilizer. The calcium bicarbonate, remains in solution in the water whence it may be taken in the various ways mentioned above. The aluminum remains with the silicic acid making kaolin the chief ingredient of clay or shale. In both these cases not all of the silicic acid remains with the aluminum but may stay in the water causing the petrifaction of wood, the silicification of fossils, or the formation of flint in lava or chert in limestone.

The electricity of thunderstorms and the soil bacteria of humus produce the nitric acid for the above reactions.

Carbonic acid is composed of carbondioxid and water loosely held together, but they are nearly always together. The amount of carbondioxid in the atmosphere is small, only three or four parts in ten thousand. The atmosphere receives its carbondioxid from the expirations of all animals and plants, from all fires and from volcanoes; it loses carbondioxid in all food-making by green plants for themselves and all other organisms, including animals, and in the formation of carbonates, such as sodium, potassium and calcium carbonates.

Tyndall states that his experience proves that the .05 percent of carbondioxid in the atmosphere serves as a blanket to keep the heat of the sun on the earth after it gets here. Tho small in amountit has a great influence on climate.

THE KANSAS ACADEMY OF SCIENCE, ITS POSITION AND MISSION[1]

WILLIAM B WILSON
Ottawa University, Ottawa Kansas

Members of the Kansas Academy of Science and friends. The organization under whose auspices we meet tonight has had a long and very notable career. I take it as a distinct honor to have been given the chance to serve as its head for the provisional term. As I am about to pronounce this retiring address many thoughts crowd into my consciousness seeking expression. One of the first of these is the thought of the indifferent attitude of the public mind and even that of the governing body of our state toward the support of an institution like ours. In an age filled with jazz and love of cheap popular entertainment I suppose it is not to be wondered at that we may meet here and announce great theses and present the solution and sequel of great secrets that have been locked in some heart from birth and not so much as get a headline in the public press. But when the governing body of our state living in a scientific age, so called at least, can not see enough in these proceedings to grant even limited publication at state expense we either wonder what is wrong with the work we are so earnestly engaged in or else we marvel at the shortsightedness of the governing body of our state. However that may be, I do not intend to discuss this question, but desire only to call attention vividly to a neglect of our cause as an academy which is greatly to be regretted. Sometime in the not too distant future I hope this organization will undertake to set its legitimate claims before our legislature with an earnestness and effectiveness which will brook no denial, else that we may be able to endow our academy with funds enough for publication purposes. Many academies in other states get state help in publishing their proceedings. Some of our leaders doubt the value of state support for a cause like ours. Yet, it does seem to some of us, many of us in fact, that the dissemination of scientific knowledge is so important that the expenditure of a few hundred dollars might be afforded by a state which appropriates multiplied thousands readily for schemes and things which do not and can not justify the claims of their advocates. I conclude this line of thought by suggesting that we will do well to examine ourselves and see if we, the members, have been jealous of our academy's interests and have sought to establish our claim that the organization is worthy of a large place in the commonwealth.

1. Presidential address delivered before the Kansas Academy of Science, April 19, 1930, at Hays Kansas.

The second thing that comes to my mind is my recently acquired knowledge of the fact that little is known of our history as a scientific society, even by our own members, and as to our position among scientific societies even less is known. I wonder how many know that the Kansas Academy of Science was started under the name "Kansas Natural History Society"? Nothing in Kansas is old so we can not claim any virtue of hoary age. Yet the first meeting of our Academy was held in Topeka September 1, 1868. Its charter members, about twenty in number, were moved by an impulse to effect an organization for the cultivation of science particularly in relation to the State of Kansas. These forward looking organizers felt, "That associated effort enhanced the growth of scientific enterprise, promoted the search for truth and helped lay at the feet of oncoming generations the scientific heritage of the past." They set forth certain facts and principles which are worthy of our consideration and perpetuation. The first of these is, that the method of procedure in the promotion of the truth in this age is very different from that which held sway in the past. Our founders declared, "The ancient logic is fruitless as a means for discovery of the truth". Neither the speculative philosophy of the past nor the dogmatism which has held sway will ever do for a scientific age. The scientific spirit prompts one to inquire what is truth. Truth is to be found at all hazards and bought at any price. All known things are to be laid under contribution. New appliances are to be constructed, and new methods of analysis invented until we stand if possible face to face with truth. Our founders declared that the spirit of the present age is fearless. All truth must be consistent with itself. Facts can not contradict each oher. Laws may not disprove each other. Scientific men are willing therefore to follow truth wherever it leads. The most venerable errors of the past, cherished and embalmed in the human heart nevertheless must be destroyed. Science lays its hands even on revelation itself and gives it a new interpretation. The results of inductive investigation are almost beyond belief. The darkness of the past was profound. Out of darkness and chaos have come all our civil and religious freedom, all our philanthropy and benevolence, all our comfort and luxury, most of our good manners and morals, largely as a result of the scientific spirit.

"As the inductive philosopher seated himself before the chaff heaps of antiquity to winnow out the grains of truth, a mighty task was laid upon him." Every premise must be thoroughly established, every observation reobserved, every experiment reconducted, and every comparison restated. Nothing less than a new creation lay before him. It is clear that little could be accomplished by individuals alone. Organization was inevitable. It was the impulse that gave

birth to our academy. Its proponents felt the need of getting together. Scientists were in need of opportunity to compare results and effect changes. "They needed to be inspired to go forth in the field of nature in the presence of other explorers."

I feel certain our members will be interested in some facts I have been able to collate from a study of other organizations like our own in America. I have had correspondence with at least ten of our state academies of science in this middle western region. Besides that I am indebted to Secretary Burton E. Livingston of the American Association for the Advancement of Science for help and especially must I give credit to Dr. Wilhelm Segerblom of the New Hampshire Academy of Science for facts taken from his presidential address on the subject "State Academies of Science Affiliated with the American Association for the Advancement of Science" delivered June 4, 1927.

There are at the present time twenty-one state academies affiliated with the American Association for the Advancement of Science. Because of this affiliation it has been easier to collect data from them. All the ten organizations with which I corresponded are affiliated and all their secretaries responded promptly with answers to the questions presented. In some cases additional information was sent. The oldest institution of that sort in our country seems to be the New Orleans Academy, founded in 1853, if we compare only purely scientific organizations. The Maryland Academy is the pioneer in this field by many decades if we take in all its history and affiliations for it was instituted in 1797 as the Academic Society of Maryland. Then in 1819 it was changed to the American Academy of Science and Latin and in 1866 reduced to its present name and scope. The Alabama Academy is the youngest, starting in 1924.* The number of members varies from fifty for New Orleans to over nine hundred for Indiana. The small number of the former is due probably to its being largely confined to research workers of that locality while the very great number of the latter is due to the heavy enrollment of non-resident members. The Kansas Academy has over two hundred fifty members and if all who are enrolled would pay their dues we could claim about three hundred. The classification of the members follows no general principle but offers almost as many variations as there are academies. Starting with New Orleans we find one class (active) members only. New Hampshire has two, active and honorary. Ours has three; annual, honorary, and life members. Maryland has six kinds; corresponding, associate, corporate, fellows, patrons, and founders. Four academies have national members, meaning all of those who are members of the American Association for the Advancement of Science. Thirteen have less than five kinds, two have six kinds, seven have non-resident members, twelve have honorary members. It is

*A recent report credits a Pacific Coast Academy as youngest but I have no definite report from it.

interesting to compare honorary members. New Hampshire limits them to ten. Kentucky to 20; Ohio to 25; and both Kentucky and Ohio limit this favor to nonresidents only. Two, Michigan and Wisconsin, confer this honor only for distinguished service to science, arts, or letters, while Tennessee has a clause in its constitution which confers it on "Any white person who has attained prominence in any department of science." It is plain then that classification is local in its actuating principle. Someone of prominence has suggested that the affiliated academies might and should have closer agreement in the nomenclature and classification of their members.

The qualification of members is variable also. New Hampshire is the only one I found fixing the age limit. One must be at least twenty-five years old to become a member. There is no retiring age in any. Few have any definite qualifications for members; "Interested in science" being the common one. A few specify proficiency in some branch of science and one or two limit to original research. Membership committees are not apt to turn down anyone who is interested in or appreciative of the work of science or desires self-improvement. The academies are very democratic and offer the best of opportunity for social and educational contacts, our own not being behind in this respect.

The annual dues are moderate in all. Our academy seems to be about regular in this matter. A fee of $1.00 is popular. Four academies require an initiation fee of $1.00. Four $2.00, one $3.00, and one, Maryland, $5.00. A fee of $20.00 in Illinois, $25 in Michigan and Nebraska and $50 in Virginia entitles one to life membership. Our own requires $25.00 or the payment of twenty-five annual dues. In Indiana, Nebraska, N. Carolina, Ohio, $100 pays for standing as a patron but in Virginia $1000.00 is required for this honor. It is interesting to note the varied names for academy publications. Ours is called "Transactions" and several use that name. "Proceedings" is popular "Journal" and "Annual Reports" is the name most frequently employed. "Abstracts" is the title used by one and "News-Letter by another.

The states finance their academies in two principal ways. In the first the states assume the financial obligation entirely. Two of these states, Indiana and Wisconsin, appropriate $1500.00 annually. In the second, this is done indirectly through the state university or some state college. Several have adopted this method. In North Carolina it is divided between the university and the academy. In a number of states the academies are planning endowments to finance publication. Some have not entered the field of publication extensively and regularly. Kansas, Iowa, and Indiana stand at the head of the list in regular publications and have more than thirty volumes each

to their credit. New Hampshire is alone in having no published proceedings to its credit, but it has furnished its members mimeograph copies of a News-Letter containing items about members, programs, announcements of meetings and abstracts of papers prepared by members. This academy has put out also a hand book of the geology of New Hampshire from funds of the organization.

Nine academies have no libraries. Michigan merges its library with that of the state university, while Kansas and Iowa deposit their books in the university libraries. Eight have separate libraries. Tennessee has only a few volumes, Illinois a few, Ohio about 300, Indiana 6000, Wisconsin more than 6000 with 700 exchanges. Our own books number 4000 at present.

The Maryland academy is the only one on the list of affiliated academies which owns its own building. Nine academies are incorporated, which would seem to indicate plans for future material resources and broad activities.

Four academies have museums. The Peale Museum established in 1797 in Maryland is the outstanding one in American academies. It is making a steady growth, is housed in its own building, has regular open hours for the public and is open to its members at all hours of the usual reader's day. Our museum has been merged with that of the state at Topeka.

The meetings of the academies are held once annually in the great majority. Fifteen of the twenty-one affiliated ones follow this plan. A very few specify that extra meetings may be called by the councils, notably Georgia and Oklahoma.

Eleven of these institutions make field trips a part of their programs at the annual meeting. Indiana and Oklahoma hold these in the spring as separate meetings and devote the field trips to inspecting industrial plants and visiting regions of biological and geological interest. The reading of papers is reserved for the winter meetings. Illinois specifies that its field trips are designed to stimulate interest in local flora, fauna, geology and industries. At least eight have no field trips as a part of their activities. I have purposely omitted Maryland from the list here because it is unique in that it meets every night in the year except Sunday and holidays but this institution is really a school for public instruction in science. I have no further data on its programs except its activities are varied and leaders are selected from its most competent members who guide and instruct in the principles and findings of science in general. In short it is a public school for the dessimination of scientific knowledge. In most of the academies papers only constitute the program. Others include addresses by able visitors from other states or from abroad,

Kansas being in this list. A few, Nebraska being one, list demonstrations and exhibits as a part of every program. In Kansas the greatest liberality and individuality prevails for we find subjects ranging from thoughts on cancer to stone implements in Trego county, and from venomous snakes in Kansas to rainfall in Kansas in its relation to Agriculture. Demonstrations and exhibits are common much as has been the case in this annual meeting here at Hays. Kansas leads, I think, in the close relation of its papers to state interests and problems. The discussional feature of our programs all over the country is being curtailed. Nearly all set a limited time check on papers. If this were not so some programs would never be finished and the opportunity for open discussions is being eliminated of necessity. The loss of this open forum feature is being greatly missed and regretfully so by some as it takes from our programs life and collective interest. Yet as papers become more and more the reports of findings of experts on subjects to which they have given their lives who but they can discuss them? The open forum then normally resolves itself to question asking by listeners and answering of these questions by the expert. It has been suggested by many of the adademies' forward looking leaders that more attention should be given to exhibits and demonstrations such as our chemical and physical sections usually employ. No doubt this would enliven and quicken the interests of auditors and increase the attendance of visitors. Where these exhibits and demonstrations have been extensively tried the increased selling value of programs has been noticeable. One of the Ohio programs lists nine exhibits relating to zoology and botany and says the number was smaller than usual.

Presidential addresses are about equally divided between technical subjects in which the president is especially interested and subjects of broader and more general interests of science and life.

I have a long list I might read you but a few will illustrate my point:

Presidential Subjects of General Interest:

Science and letters (Bamer, Michigan)
Church and Science (Lewis, Virginia)
What is Science (Richardson, New Hampshire)
Research in Industry (Cloud, Oklahoma)
Unselfish Service of Science (Blanchard, Indiana).

Presidential Addresses of Technical Interest:

Flora of Indiana (Dean, Indiana)
Some Reactions of Man to Platinum (Howe, Virginia)
Recent Research in Atomic Structure (Jensen, Nebraska)
Geology of Certain Kentucky State Parks (Jillson, Kentucky)
Accumulation of Energy by Plants (Tanseau, Ohio).

Most of the presidents say retiring addresses should aim to inspire and stimulate and point the way to a larger vision of the Academy's obligation and mission.

Ten of the secretaries in response to inquiry said their Academies made definite effort to cooperate in making known the resources and advantages of the state in which they were located. Five cooperate a little, while four make no attempt in this way.

Numerous suggestions for helpful cooperation were suggested by this comparative study of our academies. The following appear to me to be the best and most feasible: Getting into closer touch with the educational department of the state through the teacher's association, making surveys of the state's resources and fostering research in this line; acting in an advisory capacity to state departments and inviting heads of such departments to give reports and addresses before the academy; supplying scientific information to legislatures and legislative committees affecting the state's scientific interests; and offering to the executive of the state the services of our academy in an advisory capacity. This procedure often gets reversible results. For example, in Iowa a plan is on foot for the state to furnish $2,000.00 to $3,000.00 for a biological survey, the academy to furnish the talent for this undertaking. There is room for some of that very work in Kansas.

The North Carolina academy lists a goodly number of cooperative enterprises with which it is connected. Besides publishing important papers and abstracts it encourages better scientific teaching in the schools; supplies speakers for educational meetings and high schools; offers a state prize for the best eessay by a highschool pupil on a scientific subject; arouses interest in the American Association for the Advancement of Science and works for freedom of thought of research and of teaching. Other academies encourage graduate students to do research work; promote the establishment of public parks; conduct service bureaus for public benefit; offer popular lectures on scientific subjects and seek to promote research minds in their oft-times lonely endeavors and supply suggestions for the future activety for men and women given to scientific thought.

In summation then, what are some of the things we may do besides reflecting our faith in our organization and backing our members in research efforts? I make suggestions only as follows:

1. We might continue our efforts to increase our membership. Increased members have come to us lately and if we can show these new members the worthwhileness of our organization we may continue a successful campaign for new members.

2. We might contribute more than we do to the progress of our state through surveys of her resources or conditions offering fuller knowledge of these resources and giving help in improving conditions.

3. We might arrange for occasional joint meetings of neighboring organizations of our kind and secure the benefit of excnange of ideas. Joint meetings have been suggested between Kansas and Nebraska. We might carry out this suggestion to mutual advantage some time soon. We might, at least, invite representatives from other academies to visit us and appear on our programs.

4. We might offer more encouragement to our members to join the American Association for the Advancement of Science and thus help bring it to a position where it can realize more fully the common aim of all such organizations and the broadening value of such membership.

I am not trying to disparage the efforts and accomplishments of the past. Much constructive work has been done. The thirty odd volumes of our transactions will show conclusively that scientists in Kansas have been at work. What I am suggesting is that we may do more by way of organization and promotion of scientific work in Kansas. In language of one of the addresses before the Chemistry Society of America recently, I suggest, "Hats off to the accomplishments of the past, and coats off to the tasks and problems of the future."

TABLES of CONTENTS

OF THE

TRANSACTIONS

OF THE

KANSAS ACADEMY OF SCIENCE

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—Albert B. Reagan.

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The wheat foot-rot diease in Kansas. L. E. Melchers.

Take-all disease of wheat in Kansas. R. P. White and L. E. Melchers.

Studies of foot-rot of wheat. 2nd report. L. E. Melchers and H. H. McKinney.

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TRANSACTIONS

OF THE

KANSAS

ACADEMY OF SCIENCE

Volume XXXIV

Sixty-third Annual Meeting

April 23-25, 1931

University of Kansas

Lawrence, Kansas

Printed by Kimball Printing Co.
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CONSTITUTION*

SECTION 1. This association shall be called the Kansas Academy of Science.

SEC. 2. The objects of this Academy shall be to increase and diffuse knowledge in various departments of science.

SEC. 3. The membership of this Academy shall consist of three classes: annual, life and honorary.

(1) Annual members may be elected at any time by the committee on membership, which shall consist of the secretary and other members appointed annually by the president. Annual members shall pay annual dues of one dollar, but the secretary and treasurer shall be exempt from the payment of dues during the years of their service.

(2) Any person who shall have paid thirty dollars in annual dues, or equivalent due to legal exemption, or in one sum, or in any combination, may be elected to life membership, free of assessment, by a two-thirds vote of the members present at an annual meeting.

(3) Honorary members may be elected because of special prominence in science upon written recommendation of two members of the Academy, by a two-thirds vote of the members present. Honorary members pay no dues.

SEC. 4. The officers of this Academy shall be chosen by ballot at the annual meeting, and shall consist of a president, two vice presidents, a secretary and a treasurer, who shall perform the duties usually pertaining to their respective offices. The president, the secretary and the treasurer shall constitute the executive committee. The secretary shall be in charge of all the books, collections and material property belonging to the Academy.

SEC. 5. Unless otherwise directed by the Academy, the annual meeting shall be held at such time and place as the executive committee shall designate. Other meetings may be called at the discretion of the executive committee.

SEC. 6. This constitution may be altered or amended at any annual meeting by a vote of three-fourths of attending members of at least one year's standing. No question of amendment shall be decided on the day of its presentation.

Sec. 7. This Academy shall have an executive council consisting of the president, the secretary, the treasurer, the vice presidents, the chairmen of the sections and the retiring president, and other members to be nominated by the nominating committee and elected as the other officers. This council shall have general oversight of the Academy not otherwise given by this Constitution to officers or committees.

*As modified by amendments.

BY-LAWS

I. At the beginning of each annual session there shall be held a brief business meeting for announcements and appointment of committees. For the main business meeting, held later in the session, the following order is suggested:

1. Reports of officers.
2. Reports of standing committees.
3. Unfinished business.
4. New business.
5. Reports of special committees.
6. Election of officers.
7. Election of life and honorary members.

II. The president shall deliver a public address on the evening of one of the days of the meeting, at the expiration of his term of office.

III. No meeting shall be held without a notice of the same having been published in the papers of the state at least thirty days previous.

IV. No bill against the Academy shall be paid by the treasurer without an order signed by the president and secretary.

V. Names of members more than one year in arrears in dues shall be dropped from the membership list.

VI. The secretary shall have charge of the distribution, sale and exchange of the published Transactions of the Academy, under such restrictions as may be imposed by the executive committee.

VII. Ten per cent of the active membership shall constitute a quorum for the transaction of business. Section meetings may not be scheduled or held at the time a business meeting is called by the president at a general session or announced on the program.

VIII. The time allotted to the presentation of a single paper shall not exceed fifteen minutes.

IX. No paper shall be entitled to a place on the program unless the manuscript, or an abstract of the same, shall have been previously delivered to the secretary.

X. Section programs may be arranged by the secretary with the advice of the section chairman. The subdivision or combination of existing sections shall be dependent upon the number of papers to be presented. Such changes shall be made by the secretary in accordance with the policies of the Academy and after receiving the advice of the chairmen of the sections concerned.

XI. Section chairmen for the ensuing year shall be elected annually at the close of the section meetings.

XII. Section programs shall be limited to Friday afternoon of the annual session, but may be continued Saturday afternoon if desired by the section chairman. Exceptions to this must receive the approval of the executive committee.

PAST PRESIDENTS

1869—1870	B. F. Mudge
1871—1873	John Fraser
1874—1878	F. H. Snow
1879—1880	B. F. Mudge
1881—1882	J. T. Lovewell
1883	A. H. Thompson
1884—1885	R. J. Brown
1886	E. L. Nicnols
1887	J. D. Parker
1888	J. R. Mead
1889	J. R. Dinsmore, Jr.
1890	G. H. Failyer
1891	Robert Hay
1892	E. A. Popenoe
1893	E. H. S. Bailey
1894	L. E. Sayre
1895	Warren Knaus
1896	D. S. Kelley
1897	S. W. Williston
1898	D. E. Lantz
1899	E. B. Knerr
1900	A. S. Hitchcock
1901	E. Miller
1902	J. T. Willard
1903	J. C. Cooper
1904	Edward Bartow
1905	L. C. Wooster
1906	F. O. Marvin
1907	J. A. Yates
1908	E. Haworth
1909—1910	F. B. Dains
1911	J. M. McWharf
1912	F. W. Bushong
1918	A. J. Smith
1914	W. A. Harshbarger
1915-16	J. A. G. Shirk
1916-17	J. E. Todd
1917-18	F. U. G. Agrelius
1918-19	L. D. Havenhill
1919-20	R. K. Nabours
1920-21	O. P. Dellinger
1921-22	Roy Rankin
1922-23	R. K. Nabours
1923-24	H. P. Cady
1924-25	H. H. Nininger
1925-26	J. E. Ackert
1926-27	H. J. Harnly
1927-28	Mary T. Harman
1928-29	L. D. Wooster
1929-30	W. B. Wilson
1930-31	Hazel E. Branch

MEMBERSHIP OF THE ACADEMY

OCTOBER 1, 1931

Abbreviations: The following abbreviations for institutions have been used.

K. S. C. Kansas State College.

K. S. T. C. Kansas State Teachers College.

U. of K. University of Kansas.

Ft. Hays K. S. C. Fort Hays Kansas State College.

Other abbreviations follow those used in the Summarized Proceedings of the American Association for the Advancement of Science.

The year given indicates the time of election to membership.

HONORARY MEMBERS

Barber, Marshall A., Ph. D., 1904, Internat. Health Div., Rockefeller Found., 61 Broadway, New York, N. Y.

Cockerell, T. D. A., D. Sc., 1908, prof. zoology, Univ. Colorado, Boulder, Col.

Franklin, W. S., Sc. D., 1897, prof. physics, Mass. Inst. Tech., Cambridge, Mass.

Franklin, Edward Curtis, Ph. D., 1884, prof. chemistry, Leland Stanford Jr. Univ., Cal.

Grimsley, G. P., Ph. D., 1896, geological eng., B. & O. R. R., 4405 Underwood Road (Guilford), Baltimore, Md.

Hitchcock, A. S., Sc. D., 1892, principal botanist, U. S. Dept. Agric., Washington, D. C.

Harris, J. Arthur, Ph. D., 1900, head Dept. Botany, Univ. Minnesota, Minneapolis, Minn. (Deceased).

Kellogg, Vernon L., LL. D., Sc. D., 1920, permanent sec. National Research Council, Washington, D. C.

McClung, C. E., Ph. D., 1903, dir. Zoology Lab., Univ. Pennsylvania, Philadelphia, Pa.

McCollum, E. V., Ph. D., Sc. D., 1902, prof. biochemistry, John Hopkins Univ., Baltimore, Md.

Nichols, Edward L., Ph. D., Sc. D., 1885, (honorary member 1897), prof physics (emeritus) Cornell Univ., Ithica, N. Y.

Riggs, Elmer S., M. A., 1896, assoc. curator paleontology, Field Mus. Nat. Hist. Chicago, Ill.

Wagner, George, M. A., 1897, (honorary member 1904) assoc. prof. zoology, Univ. Wisconsin, Madison, Wis.

LIFE MEMBERS

Agrelius, Frank U. G., M. A., 1905, assoc. prof. biol., K.S.T.C., Emporia, Kan.

Allen, Herman Camp, Ph. D., 1904, prof. chemistry, U. of K., Lawrence, Kan.

Bailey, E. H. S., Ph. D., 1883, prof. chemistry, U. of K., Lawrence, Kan.

Bartholomew, Elam, Sc. D., 1896, 415 W. Sixth St., Hays, Kan.

Bartow, Edward, Ph. D., Sc. D., 1897, prof. and head of Dept. of Chemistry and Chem. Engr., Univ. Iowa, Iowa City, Iowa.

Baumgartner, William J., Ph. D., 1904, assoc. prof. zoology, U. of K., Lawrence, Kan.

Beede, Joshua W., Ph. D., 1894, prof. geology and paleontology, Indiana Univ., Bloomington, Ind.

Berry, Sister M. Sebastian, A. B., 1911, Supt. Schools, St. Paul, Kan.
Bushnell, Leland D., Ph. D., 1908, prof. and head Bacteriology Dept., K. S. A. C., Manhattan, Kan.
Bushong, F. W., Sc. D., 1896, 2636 Fifth St., Port Arthur, Tex.
Cady, Hamilton P., Ph. D., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Copley, Rev. John T., 1903, Olathe, Kan.
Cragin, F. W., Ph. D., 1880, 912 Migeul St., Colorado Springs, Col.
Crevecoeur, F. F., 1900, Onaga, Kan. (Deceased).
Cook, W. A., M. S., 1907, real estate business, 1414 Highland St., Salina, Kan.
Dains, Frank Burnett, Ph. D., 1902, prof. chemistry, U. of K, Lawrence, Kan.
Deere, Emil O., M. S., 1905,, dean and prof. biology, Bethany Col., Lindsborg, Kan.
Dellinger, Orris P., Ph. D., 1909, prof. biology, K. S. T. C., Pittsburg, Kan.
Dunlevy, R. B., M. A., 1896, Southwestern Col., Winfield, Kan.
Eby, J. Whit, B. S., 1903, banker, Howard, Kan.
Failyer, George H., M. S., 1879, retired, R. R. 4, Manhattan, Kan.
Faragher, Warren Fred, Ph. D., 1927, research chemist, Universal Oil Produce Co., Riverside, Ill.
Garrett, A. O., M. A., 1901, head Dept. Biology, East High School, Salt Lake City, Utah.
Graham, I. D., M. S., 1879, State Board of Agric., Topeka, Kan.
Harman, Mary T., Ph. D., 1912, prof. zoology, K. S. C., Manhattan, Kan.
Harnly, Henry J., Ph. D., 1893, prof. biology, McPherson Col, McPherson, Kan.
Harshbarger, William A., Sc. D., 1903, prof. mathematics, Washburn Col, Topeka, Kan.
Havenhill, L. D., Ph. C., 1904, dean School Pharmacy, U. of K., Lawrence, Kan.
Haworth, Erasmus, Ph. D., 1882, U. of K., Lawrence, Kan.
Knaus, Warren M., D. Sc., 1882, entomologist, editor "Democrat Opinion", McPherson, Kan.
McWharf, J. M., M. D., 1902, 715 Princeton St., Ottawa, Kan.
Meeker, Grace R., A. B., 1899, 709 S. Mulberry, Ottawa, Kan.
Menninger, C. F., M. D., 1903, 3617 W. 6th Ave., Topeka, Kan.
Miller, Ephraim, Ph. D., 1873, 558 North Lakes Ave., Pasadena, Cal. (Deceased.)
Nabours, Robert K., Ph. D., 1910, prof. and head Zoology Dept., K. S. C., Manhattan, Kan.
Nissen, A. M., A. B., 1888, farmer, Wetmore, Kan.
Peace, Larry M., 1904, 512 West Ninth St., Lawrence, Kan.
Robertson, W. R. B., Ph. D., 1905, Anat. Dept., Univ. Iowa, Iowa City, Ia.
Reagan, Albert B., Ph. D., 1904, Indian Field Service, Ouray, Utah.
Schaffner, John H., M. S., 1903, research and prof. botany, Ohio State Univ., Columbus, Ohio.
Scheffer, Theodore, M. A., 1903, assoc. biologist, U. S. Biological Survey, Puyallup, Wash.
Shirk, J. A. G., 1904, prof. mathematics, K. S. T. C., Pittsburg, Kan.
Smith, Alva J., 1892, consulting eng., 810 Boylston St., San Diego, Cal.
Smyth, Lumina C. R., Ph. D., 1902, 235 Acton Road, Columbus, Ohio.
Sterling, Charles M., A. B., 1904, assoc. prof. botany and pharmacognosy, U. of K. Lawrence, Kan.
Sternberg, Charles H., M. A., 1896, 4046 Arizona St., San Diego, Cal.
Stevens, Wm. C., 1890, head Botany Dept., U. of K., Lawrence, Kan.
Welin, John Eric, D. Sc., 1889, prof. chemistry, Bethany Col., Lindsborg, Kan.
Willard, Julius T., D. Sc., 1883, vice-pres. K. S. C., Manhattan, Kan.
Wilson, William B., Sc. D., 1903, head Biology Dept., Ottawa Univ., Ottawa, Kan.
White, E. A., M. A., 1904, prof. chemistry, U. of K., Lawrence, Kan.
Wooster, Lyman C., Ph. D., 1889, prof. biology and geology, K.S.T.C., Emporia, Kan.
Yates, J. A., Ph. D., 1898, prof. chemical and physical science, K.S.T.C., Pittsburg, Kan.

ANNUAL MEMBERS

Members paid up for 1931 are indicated by an asterisk*. The year given is that of election to membership. If two years are given, the second signifies reelection.

*Ackert, James E., Ph. D., 1919, prof. zoology and parasitologist, dean Graduate Div., K. S. C., Manhattan, Kan.
*Aicher, L. C., B. S., 1930, supt. Ft. Hays Branch, K. S. A. Expt. Sta., Hays, Kan.
*Albertson, F. W., B. S., 1928, assoc. prof. agr c., Hays, Kan.
Albright, Penrose S., M. S., 1926, asst. prof. physics and chemistry, Southwestern Col., Winfield, Kan.
Allen, Fred W. Jr., M. A., 1927, 317 Stanford, Albuquerque, N. M.
*Alm, O. W., Ph. D., 1931, assoc. prof. psychology, K. S. C., Manhattan, Kan.
*Ayres, H. D., 1928, Univ. Wichita, Wichita, Kan.
*Babcock, Rodney W., Ph. D., 1931, dean, Div. Gen. Sci., K. S. C., Manhattan, Kan.
*Baden, M. W., Sc. D., 1929, Box 520, Winfield, Kan.
*Bahl, Julius R., 1931, senior, Ft. Hays K. S. C., Hays, Kan.
*Barham, Harold N., Ph. D., 1931, asst. prof. chemistry, K. S. C., Manhattan, Kan.
Barker, J. F., A. B., 1930, student, U. of K., Lawrence, Kan.
*Barnett, R. J., M. S., 1922, prof. horticulture, K. S. C., Manhattan, Kan.
Bartley, S. H., A. M., 1930, inst. psychology, U. of K., Lawrence, Kan.
*Barton, A. W., Ph. D., 1928, prof. botany, Fort Hays K. S. C., Hays, Kan.
*Beach, Edith, 1931, 812 Illinois St., Lawrence, Kan.
*Beamer, Raymond H., Ph. D., 1931, asst. prof. entomology, U. of K., Lawrence, Kan.
*Bender, Paul, M. S., 1931, prof. physical sciences, Hesston Col., Hesston, Kan.
*Bennett, Dewey, M. A., 1928, head science dept., Junior Col., Garden City, Kan.
*Bennett, James, L., M. A., 1928, prof. physics, Ottawa Univ., Ottawa, Kan.
*Bird, J. S., B. S., 1929, pres. Wheat Farming Co., Hays, Kan.
*Boone, George N., M. S., 1930, Indust Educ. Dept., McPherson Col., McPherson, Kan.
*Bowman, J. L., M. S., 1928, McPherson Col., McPherson, Kan.
*Broughton, L. L., B. S., 1929, instr. pharmacy, U. of K., Lawrence, Kan.
*Bradbury, Dorothy, Ph. D., 1929, Oklahoma Col. for Women, Chickasha, Okla.
*Branch, Hazel E., Ph. D., 1924, prof. zoology, Wichita Univ., Wichita, Kan.
*Breukelman, John, Ph. D., 1930, prof. biology, K. S. T. C., Emporia, Kan.
*Brewster, Ray Q., Ph. D., 1919, prof. chemistry, U. of K., Lawrence, Kan.
*Brigden, Robert L., A. B., 1931, lab. asst., U. of K., Lawrence, Kan.
*Brooks, Charles H., B. S., 1928, instr. corres. study, Hays, Kan.
*Brown, J. C., M. D., 1931, 1010 Schweiter Building, Wichita, Kan.
*Brown, Maud A., 1929, bur. sch. health service, U. of K, Lawrence, Kan.
*Brownlee, J. A., 1931, High School, Wichita, Kan.
*Brubaker, H. W., Ph. D., 1929, prof. chemistry, K. S. C., Manhattan, Kan.
*Bruce, J. B., A. B., 1931, chemistry, Iola Junior Col., Iola, Kan.
*Brungardt, Bernard J., B. S., 1930, prin. and sci. teacher, Schoenchen, Kan., P. O., Hays, Kan.
*Burger, Oskar K., Ph. D., 1931, prof. chemistry, St. Benedict's Col., Atchison, Kan.
*Burt, Roy A., B. S. 1923, geologist, 56th & Shawnee Mission Road, Kansas City, Kan.
*Call, L. E., M. S., 1922, dean, Div. Agric., Director Agric. Exp. Sta., K. S. C. Manhattan, Kan.
*Campbell, Marion I., M. S., 1929, Charlotte Swift Hospital, Manhattan, Kan.
*Carpenter, A. C., 1929, president, Lesh Oil Co., Ottawa, Kan.
*Challans, Joanna S., M. S., 1928, Halstead, Kan.
*Chapman, O. W., Ph. D., 1931, prof. chemistry, K. S. T. C., Pittsburg, Kan.
*Clarke, J. C., 1928, custodian Wupatki Nat'l. Mon., Flagstaff, Ariz.
*Cooke, Elma Viola, 1931, student, K. S. T. C., Emporia, Kan.
*Coonfield, Ben R., Ph. D., 1927, Dept. Biology, Brooklyn Col., Brooklyn, New York.
*Corey, Wm. Lee, D. P. H., D. C., 1930, chiropractic physician, 701 1-2 Cleveland Ave. Kansas City, Mo.
*Cowan, Edwina, Ph. D., 1929, dir. Wichita Child Research Lab., Friends Univ., Wichita, Kan.
*Cromer, Mrs. Alice Worden, B. S., 1928, Wellington, Kan.
*Crow, H. Ernest, A. M., 1926, prof. biology, Friends Univ., Wichita, Kan.

*Cruise, Lawrence B., A. B., 1930, physics and math., Junior Col., Rochester, Minn.
*Cutsforth, Thomas D., Ph. D., 1931, Carnegie Res. Fellow, U. of K., Lawrence, Kan.
*Dalbey, Nora E., 1929, prof. botany, K. S. C., Manhattan, Kan.
*Davidson, Arthur W., Ph. D., 1927, assoc. prof. chemistry, U. of K., Lawrence, Kan.
*Davis, Rex H. A., 1931, Atchison H. S., Atchison, Kan.
Davis, P. H., B. S., 1930, asst Soil Chemist, Branch Expt. Sta., Hays, Kan.
*Dean, George A., M. S., 1912, head Dept. Entomology, K. S. C., Manhattan, Kan.
*Dellett, Fred V., 1931, student, Ft. Hays K. S. C., Hays, Kan.
*Dempsey, Esther, A. B., 1931, asst. botany, Baker Univ., Baldwin, Kan.
*Denio, Elgin A., B. S., 1931, Greeley, Kan.
*DePuy, Percy L., M. S., 1929, instr. animal husb., K. S. C., Manhattan, Kan.
*DeSilva, H. R., Ph. D., 1930, psychology, U. of K., Lawrence, Kan.
*Dick, E. G., B. S., 1931, physics, El Dorado Jr. Col., El Dorado, Kan.
*Dobrovolny, Chas. G., B. A., 1930, tech. and instr. zoology, K. S. C., Manhattan, Kan.
*Dobrovolny, Mrs. Marjorie Prickett, M. S., 1930, Dept. Zoology, K. S. C., Manhattan, Kan.
Doell, J. H., A. B., 1926, prof. biology, Bethl Col., Newton, Kan.
*J. R. Douglass, M. S., 1928, asst. entomologist, U. S. Bur. Ent., Estancia, N. M.
*Downs, Roy Henry, 1931, student, K. S. T. C., Emporia, Kan.
Drake, J. P., M. A., 1930, prof. physics, K. S. T. C., Emporia, Kan.
*Dresher, C. H., 1930, science and algebra, Junior H. S., McPherson, Kan.
*Duley, F. L., Ph. D., 1929, prof. soils, Agronomy Dept., K. S. C., Manhattan, Kan.
*Dunn., J. F., Jr., 1931, student, Univ. Wichita, Wichita, Kan.
*Eichman, John I, B. S., 1931, student, Ft. Hays K. S. C., Hays, Kan.
*Eitzen, A. Clement, M. D., 1931, Hillsboro, Kan.
*Elias, Maxim K., Min. Eng., 1931, geoligist, Geol. Survey of Kansas, Lawrence, Kan.
Emery, W. T., M. A., 1928, science instr., High School North, Wichita, Kan.
*Evans, Neal E., M. S., 1926, instr. Marquette U., Milwaukee, Wis.
*Evers, Robert A. 1931, 1018 Bluemont, Manhattan, Kan.
*Everhardy, Louise A., M. A., 1931, assoc. prof. art., K. S. C., Manhattan, Kan.
*Farrell, F. D., B. S., 1924, president K. S. C., Manhattan, Kan.
*Figley, John L., 1931, senior, Southwestern Col., Winfield, Kan.
Fleming, Joe, 1930, student, K. S. T. C., Emporia, Kan.
*Fletcher, Worth A., Ph. D., 1928, prof. chemistry, Univ. Wichita, Wichita, Kan.
*Floyd, E. V., 1929, prof. physics, K. S. C., Manhattan, Kan.
*Foard, Castle W., Ph. D., 1930, Youngstown, Col., Youngstown, Ohio.
*Ford, Helen, Ph. D., 1928, head Dept. Child Welfare and Euthenics, K. S. C., Manhattan, Kan.
*Foreman, Henry, B. S., 1931, grad. student, 413 W. 5th St., Hays, Kan.
*Foster, Mark A., A. B., 1931, grad. student zoology, K. S. C., Manhattan, Kan.
*Fraser, S. V., 1931, Catholic priest, Aurora, Kan.
*Fryar, Raymond, 1930, Ft. Hays K. S.. C., Hays, Kan.
*Fulton, John H., B. S., 1931, R. 1, Box 31, Glen Elder, Kan.
*Fyfe, Robert C., A. B., 1931, student in zoology, U. of K., Lawrence, Kan.
*Gainey, P. L., Ph. D., 1931, prof. bacteriology, K. S. C., Manhattan, Kan.
Garanson, Clifford E., B. S., 1927, Dwight, Kan.
Garrett, Frank A., B. S., 1929, instr. chemistry and physics, High School, Halstead, Kan.
*Gates, F. C., Ph. D., 1922, prof. botany, K. S. C., Manhattan, Kan.
George, P. W., 1929, care of Buchans Mining Co., Buchans, Newfoundland.
*Gloyd, Howard K., M. S., 1922, instr. zoology, Univ. Michigan, Ann Arbor, Mich.
*Goldsmith, William M., Ph. D., 1924, prof. biology, Univ. Wichita, Wichita, Kan.
*Goodrich, Arthur L., Jr., M. S., 1931, instr. zoology, K. S. C., Manhattan, Kan.
*Gottlieb, Selma, Ph. D., 1931, chemist, Water Lab., U. of K., Lawrence, Kan.
Greeder, Herman, D. V. M., 1928, box 387, Wichita, Kan.
*Greene, Clarence A., 1931, student asst., Kan. Wes. Univ., Salina, Kan.
*Greep, Roy A., B. S., 1930, grad. asst., Univ. Wisconsin, Madison, Wis.

Gregory, P. W., Sc. D., 1929, prof. zoology, Baker Univ., Baldwin, Kan.
Griswold, Sherwin B., B. S., 1930, prin. rural H. S., Hunter, Kan.
*Grimes, Waldo E., Ph. D., 1925, head, Dept. Agric. Econ., K. S. C., Manhattan, Kan.
*Griner, A. J., 1931, 1108 Oak St., Kansas City, Mo.
Gustafson, Vernon, 1930, McPherson, Col., McPherson, Kan.
Hall, E. Raymond, Ph. D., 1923, 1929, curator mammals Museum Vertebrate Zool· Univ. Calif., Berkeley, Calif.
*Hall, J. Lowe, Ph. D., 1929, asst. prof. chemistry, K. S. C., Manhattan, Kan.
*Hallstead, A. L., 1929, Hays, Kan.
*Hamilton, J. O., B. S., 1919, 1929, prof. phys'cs, K. S. C., Manhattan, Kan.
*Hâncin, John, 1931. 644 Gypsum, Salina, Kan.
*Harbaugh, M. J., M. A., 1930, asst. prof. zoology, K. S. C., Manhattan, Kan.
*Harper, Bernice, M. S., 1939, Vicksburg, Michigan.
*Harris, C. L., Ph. M., 1928, attorney-at-law, Box 1088, Eldorado, Kan.
*Harris, Maxwell, A. B., 1931, grad. student, U. of K, Lawrence, Kan.
*Hartel, Lawrence, M. S., 1930, asst. prof. phys'cs, K. S. C, Manhattan, Kan.
*Hartley, Clara, 1931, Baker Univ., Baldwin, Kan.
*Hartman, Hugh E., B. S., 1928, test eng., 537 Chautauqua Ave., Wichita, Kan.
*Harvard University Library, 1930, Cambridge. Mass.
*Haymaker, H. H., Ph. D., 1930, prof. plant pathology, K. S. C., Manhattan Kan.
*Henry, Edwin R., M. A., 1927, inst. psychology, Ohio State Univ., Columbus, Ohio
*Herrick, Earl H., Ph. D., 1927, head Biology Dept., S. N C, Natchitoches, La.
*Hershey, J. Willard, Ph. D., 1920, prof. chemistry, McPherson Col., McPherson, Kan.
*Hertzler, Arthur E., M. D., Ph. D., 1928, prof. surgery, Univ. Kansas Med'cal School, head surgeon Halstead Hosp., Halstead, Kan.
Hess, Mrs. Katherine, M. S., 1926, asst. prof. cloth ng and tectiles, K. S. C. Manhattan, Kansas.
*Hibbs, Agnes Ruth, 1931, student, K. S. T. C., Emporia, Kan.
*Hill, J. W., M. A., 1931, prof. chemistry, Tabor Col., Hillsboro, Kan.
*Hill, Robert T., M. S., 1928, Univ. Iowa, Iowa City, Iowa.
*Hodge, Harold C., Ph. D., 1931, School of Med'cine, Univ. Rochester, Rochester, New York.
*Hoffman, Wm. E., M. A., 1920, head Dept. Biology, Lingnan Univ., Canton, China.
*Hogue, Mary Evelyn, 1931, student in botany, U. of K., Lawrence, Kan.
*Horn, Elsa, M. S., 1928, instr. botany, K. S. C., Manhattan, Kan.
*Horton, John R., B. S., 1922, entomologist, U. S. Dept. Agric., 128 South Minn Ave., Wichita, Kan.
*Hudiburg, Leo E., M. S., 1931, asst. prof. phys'cs, K. S. C., Manhattan, Kan.
*Hughes, J. S., Ph. D., 1928, prof. chem'stry, K. S. C., Manhattan, Kan.
*Humphrey, Irwin, M. S., 1912, res. chemist, Hercules Powder Co., Wilmington, Del.
*Hungerford, H. B., Ph. D., head Dept. Entomology, U. of K., Lawrence, Kan.
*Ibsen, Heman L., Ph. D., 1922, prof. genetics, Animal Husb. Dept. K. S. C., Manhattan, Kan.
*Imler, Ralph H., B. S., 1931, science teacher, H'gh School, Stockton, Kan.
Jardine, W. M., Ph. D., 1919, U. S. Minister to Egypt, Cairo, Egypt.
Jehlik, Paul, 1930, student, K. S. T. C., Emporia, Kan.
*Jelinek, George, B. S., 1929, Ellsworth, Kan.
*Jewell, Minna E., Ph. D., 1925, prof. zoology, Thornton Junior Col., Harvey, Ill.
*Johnson, E. W., B. S., 1930, nurseryman, Ft. Hays Expt. Sta., Hays, Kan.
*Johnson, George E., Ph. D., 1925, prof. zoology and mammalogist, K. S. C., Manhattan, Kan.
*Johnson, Otis, B. S., 1930, mathematics, Caspar, Wyom.
*Johnston, C. O. M. S., 1928, assoc. plant pathologist, K. S. C., Manhattan, Kan.
*Justin, Margaret M., Ph. D., 1925, 1928, dean, Div. Home Economics, K. S. C., Manhattan, Kan.
*Kansas City Public Library, 1930, Kansas City, Mo.
*Kehr, R. W., B. S., 1931, asst. engr. St. Bd. Health, 1709 Indiana, Lawrence, Kan.
*Kester, F. E., Ph. D., 1929, prof. physics, U. of K., Lawrence, Kan.

*Kidd, Robert M., 1931, student asst., Kan. Wes. Univ., 440 S. 11th St., Salina, Kan.
King, H. H., Ph. D., 1909, prof. and head Dept. Chemistry, K. S. C., Manhattan, Kan.
*Kinney, Edward D., B. S, 1930, assoc. prof. and head Dept. Chemical Engineering, U. of K., Lawrence, Kan.
*Kitchen, Mary E., B. S., 1924, R. R. 1, box 38A, Larned, Kan. (Librarian Phillips
*Knight, G. L., Ph. D., 1931, asst. prof. geology, U. of K., Lawrence, Kan.
*Knowles, H. L., A. B., 1931, instr. physics, U. of K., Lawrence, Kan.
*Landes, Kenneth K., Ph. D., 1931, asst. state geologist, U. of K., Lawrence, Kan.
Landrum, Claude G., A. B., 1930, grad. student, U. of K., Lawrence, Kan.
*Lane, H. H, Ph. D., 1929, prof. and head Dept. Zoology, U. of K., Lawrence, Kan.
*Larson, Iva, M. S., 1928, asst. genetics, K. S. C., Manhattan, Kan.
*Larson, Mary E., A. M., 1925, asst. prof. zoology, U. of K., Lawrence, Kan.
*Latimer, Homer B., Ph. D., 1928, prof. anatomy, U. of K., Lawrence, Kan.
*Latshaw, W. L., 1923, 1929, prof. chemistry, K. S. C., Manhattan, Kan.
*Lawson, Paul B., Ph. D., 1919, prof. entomology, U. of K., Lawrence, Kan.
*Leeper, Robert, Ph. D., 1931, instr. psychology, Univ. Arkansas, Fayetteville, Ark.
*Lehmann, Glenn A., A. M., 1931, prof. chemistry, Friends Univ., Wichita, Kan.
*Lehman, Roy P., A. B., 1928, geologist, Sinclair Oil Co., Box 52, Ellis, Kan.
*Leist, Claude, M. A., 1929, assoc. prof. biology, K. S. T. C., Pittsburg, Kan.
*LeMaster, Lelan K., 1931, student, K. S. T. C., Emporia, Kan.
Lindahl, Glenn W., B. S., 1928, supt. schools, Munden, Kan.
*Lindley, E. H., Ph. D., LL. D., 1923, chancellor, U. of K., Lawrence, Kan.
Linsdale, Jean M., Ph. D., 1928, research assoc., California Museum Vertebrate Zoology, Univ. California, Berkeley, Cal.
*Loewen, S. L., M. A., 1931, prof. biology, Tabor Col., Hillsboro, Kan.
*Long, W. S., Ph. D., head Chemstry Dept., Kansas Wesleyan, Salina, Kan.
*Lyon, Eric, M. S., 1926, assoc. prof. physics, K. S. C., Manhattan, Kan.
*Lyon, Jeanne, M. S., 1930, 1026 Bertrand, Manhattan, Kan.
*Marsh, Richard R., M. S., 1931, Mount Oread Training School, Lawrence, Kan.
*Marten, E. A., Ph. D., 1931, assoc. prof. chem. & bacteriol., Univ. Wichita, Wichita, Kan.
*Matthews, Wm. H., B. S., 1920, assoc. prof, physics, K. S. T. C., Pittsburg, Kan.
*Maus, Pearl M., M. S., 1927, Auburn, Kan.
*Maxwell, Geo. W., M. S., 1929, asst. prof. physics, K. S. C., Manhattan, Kan.
*McCammon, Ruth, B. S., 1931, technician, food econ. and nutri., K. S. C., Manhattan, Kan.
*McClure, Kenneth F., 1931, student Univ. Wichita, Wichita, Kan.
*McCullough, Anna M., A. M., 1931, asst. prof. education, K. S. T. C., Emporia, Kan.
*McDonald, Clinton C., Ph. D., 1928, prof. botany, univ. Wichita, Wichita, Kan.
*McKinley, Lloyd, Ph. D., 1928, prof. chemistry, Univ. Wichita, Wichita, Kan.
McMasters, Belle M., B. S., 1928, student, K. S. T. C., 820 Cottonwood St, Emporia, Kan.
*McNair, Geo. T., Ph. D., 1931, asst. prof. zool., U. of K, Lawrence, Kan. (deceased)
*Melchers, Leo Edward, M. S., 1918, head Dept. Botany & Plant Pathology, K. S C., Manhattan, Kan.
*Menninger, Karl A., M. D., 1919, physician, 3617 W. 6th St., Topeka, Kan.
Messmore, H. E., E. M., 1929, grad. asst. Chemistry Dept., U of K, Lawrence, Kan.
*Michner, John, M., M. S., 1925, instr. chemistry, Wichita High School, Wichita, Kan.
Miller, A. W., M. S., 1928, instr. chemistry, Hutchinson Junior Col., Hutchinson.
*Miller, Edwin Cyrus, Ph. D., 1918, prof. botany, K. S. C., Manhattan, Kan.
*Miller, O. M., B. S., 1930, science teacher, Central Col., McPherson, Kan.
*Miller, R. F., Ph. D., 1928, prof. physics, Col. Emporia, Emporia, Kan.
*Mitchell, U. G., Ph. D., 1931, prof. mathematics, U. of K., Lawrence, Kan.
*Mix, Arthur J., Ph. D, 1931, prof. botany, U. of K., Lawrence, Kan.
*Mohler, R. E., 1929, exec. sec. Men's Work, Church of the Brethren, 22 S. State St., Elgin, Ill.

*Moore, Fleming G., Ph. D., 1927, prof. physics, Washburn Col., Topeka, Kan.
*Morris, Mary Hope, M. S., 1929, Hutchinson Junior Col., Hutchinson, Kan.
*Morrison, Beulah May, Ph. D., 1928, assoc. prof. psychology, U. of K., Lawrence, Kan.
*Mullings, Elma Lucille, 1931, student K. S. T. C., Emporia, Kan.
*Munro, Finlay, A. B., 1931, asst. instr. bacteriology, U. of K., Lawrence, Kan.
*Naismith, James, M. D., 1931, prof. physical education, U. of K., Lawrence, Kan.
*Nash, Bert, A., Ph. D., 1930, assoc. prof. ed., U. of K., Lawrence, Kan.
*Neher, S. J., B. S., 1930, instr. botany, Portis, Kan.
*Nelson, Arthur W., 1931, student, Bethany Col., Lindsborg, Kan.
*Newman, Edwin B., A. M., 1930, instr. psychology, Bryn Mawr Col, Bryn Mawr., Pa.
*Nininger, A. M., 1921, 1317 E. 18th Ave., Denver, Colo.
Nolf, L. O., Ph. D., 1928, Dept. Zoology, Univ. Iowa, Iowa City, Iowa.
*Noll, W. C., A. M., 1929, prof. biology, Col. Emporia, Emporia, Kan.
*Oman, A. E., M. F., 1928, asst. biologist, U. S. Biological Survey, 136 E. 12th St., Dallas, Texas.
*Oregon State Agric. Col., Library, Corvallis, Ore.
*Owen, F. T., Ph. D., 1931, prof. chemistry, Col. Emporia, Emporia, Kan.
*Painter, Reginald, Ph. D.' 1927, asst. prof. entomology, K. S. C., Manhattan, Kan.
*Parker, J. H., Ph. D., 1918, prof. crop. imp., Dept. Agron., K. S. C., Manhattan, Kan.
*Parks, W. B., Ph. D., 1931, prof. chemistry, K. S. T. C., Pittsburg, Kan.
*Payne, Sister Anthony, A. M., 1930, Mount St. Scholastica, Atchison, Kan.
*Perkins, Alfred T., Ph. D., 1925, 1929, 1931, asst. prof. chemistry, K. S. C., Manhattan, Kan.
*Perkins, Theodore, A. B., 1930, grad. student, U. of K, Lawrence, Kan.
*Perrine, Irving, Ph. D., 1921, oil operator, geologist, 1619-21 Petroleum Bldg. Oklahoma City, Okla.
*Peterson, J. C., Ph. D., 1919, prof. education, K. S. C., Manhattan, Kan.
*Pittman, Martha S., M. S., 1925, 1931, prof. food economics and nutrition, K. S. C., Manhattan, Kan.
*Portenier, Warren E., 1931, senior Ft. Hays K. S. C., Hays, Kan.
*Potter, Isabel, M. S., 1926, instr. biology, Winthrop Col., Rock Hill, S. C.
*Pretz, Paschal H., M. S., 1930, prof. physics St. Benedict's Col., Atchison, Kan.
*Purdy, D. McL., 1931, psychology, U. of K., Lawrence, Kan.
Putnam, Clyde L., 1930, K. S. T. C., Hays, Kan.
*Rankin, Roy, M. A., 1919, chemistry and chairman Div. Sci., Ft. Hays K. S. C., Hays, Kan.
Ratzlaff, Abe K, A. B., 1930, asst. instr. anatomy, U. of K., Lawrence, Kan.
*Readio. Philip A., Ph. D., 1928, assoc. prof. entomology, U. of K., Lawrence, Kan.
*Reed, H. B., Ph. D., 1930, prof. psychology, Ft. Hays K. S. C., Hays, Kan.
*Renich, Mary E., Ph. D., 1931, asst .prof. biol., K. S. T. C., Pittsburg, Kan.
*Richardson, Helen, 1930, student, K. S. T. C., Emporia, Kan.
*Richey, Ross, 1930, student, 1105 Vermont St., Lawrence, Kan.
*Robinson, W. J., M. S , 1928, prin. High School, Lincoln, Kan.
*Rouse, J. E., M. S., 1928, prof. agric., Ft. Hays K. S. C., Hays, Kan.
*Royer, W. D., A. B., 1927, instr. biology, Wichita H. S. East, Wichita, Kan.
*Rudie, N. H., Ph. M., 1929, science teacher, High School, Hays, Kan.
*Russom, Vaughn, A. B., 1928, field geologist, Box 681, Norman, Okla.
*Rust, Mrs. Lucille, M. S., assoc. prof. education., K S. C., Manhattan, Kan.
Salmon, S. C., M. S., 1926, prof. farm crops K S. C., Manhattan, Kan.
*Sarracino, John, B. S., 1928, 715 Iowa St., Neodesha, Kan.
*Sarvis, Byron C., A. B., 1931, asst. instr. psychology, U. of K., Lawrence, Kan.
*Sauer, F. C., A. B., 1931, asst. instr. anatomy, U of K., Lawrence, Kan.
*Savage, David A., B S., 1930, asst. agronomist. Branch Expt. Sta . Hays, Kan
*Sayre, Claude E., Ph. D., 1924, rector, St. Michael's Episcopal Church, Mount Pleasant, Iowa.
*Schaefer, Helen, 1930 instr., K. S. T. C., Emporia, Kan.
*Schaffner, D. C., A. M., 1931, geology and botany, Col. Emporia, Emporia, Kan.
*Schoewe, Walter H., Ph. D., 1925, assoc. prof. geology, U. of K., Lawrence, Kan.
*Schovee, Joseph C., 1928, asst. eng. A. T. & S. F. R. R., 1235 Boswell Ave., Topeka, Kan.
*Schrammel, H. E., Ph. D., 1929, prof. psychology, K. S. T. C., Emporia, Kan.
*Schumann, Margaret, M. A., 1922, technichian Anatomy Dept., U. of K., Lawrence, Kan.
*Seaton, Roy A., M. S., 1928, dean, Div. Engineering, K. S. C., Manhattan, Kan.
*Setty, Laural R., A. M., 1928, Emporia, Kan.
*Shadd, Geo. C., 1921, dean Engineering School, U. of K., Lawrence, Kan.
Shaw, Hubert, deG., Ph. D., 1928, St. Benedict's Col., Atchison, Kan.
*Sherbon, Florence B., M. D., 1931, prof. child care, U. of K., Lawrence, Kan.
*Showalter, Donald F., M. A., 1928, 945 Alabama St., Lawrence, Kan.

Shuler, Fred E., Ph. C., 1929, student, U. of K., Lawrence, Kan.
*Smith, Roger C., Ph. D., 1921, prof. entomology, K. S. C., Manhattan, Kan.
*Smits, Benjamin L., Ph. D., 1930, assoc. food analyst, K. S. C., Manhattan, Kan.
*Soderberg, N. B., A. B., 1931, asst. instr. anatomy, U. of K., Lawrence, Kan.
*Spencer, D. H., 1925, Pharmacy Dept., U. of K., Lawrence, Kan.
*Sperry, Arthur B., B. S., 1917, 1922, prof. geology, K. S. C., Manhattan, Kan.
*Spiker, H. M., B. S., 1931, chemistry and mathematics, Col. Emporia, Emporia, Kan.
Stanley, George, B., M. D., Ph. D., 1928, physician and surgeon, Windsor, Hosp., Windsor, Col.
Steen, Robert A., 1928, student, K. S. T. C., Emporia, Kan.
*Stephens, Homer A., B. S., 1931, teacher biology, High School, Atchison, Kan.
*Sternberg, George F., 1928, field vertebrate paleontologist, Ft. Hays K. S. C., Hays, Kan.
St[illegible], J. W. E., A. B., 1929, East High School, Wichita, Kan.
*Stoland, O. O., Ph. D., 1918, prof. pyhsiology and pharmacology, U. of K., Lawrence, Kan.
*Stoltz, Martha, M. S., 1928, asst. prof. biology, Ottawa Univ., Ottawa, Kan.
*Stone, J. R., 1923, 1929, Quartermaster's Office, U. S. Diciplinary Barracks, Ft. Leavenworth, Kan.
*Stouffer, E. B., Ph. D., 1929, dean Grad. School, U. of K., Lawrence, Kan.
*Stranathan, Ph. D., 1930, assoc. prof. physics, U. of K., Lawrence, Kan.
*Stratton, George W., Ph. D., 1931, prof. chemistry, U. of K., Lawrence, Kan.
*Studt, Charles W., M. S., 1926, chief geologist, Union Gas Co,. Independence, Kan.
*Sutter, L. A., M. D., 1923, physician, 611 First National Bank Bldg., Wichita, Kan.
*Swanson, Arthur F., M. S., 1926, agronomist, Ft.. Hays Exper. Sta., Hays, Kan.
*Taft, Robert, Ph. D., 1923, 1929, assoc. prof. chemistry, U. of K., Lawrence, Kan.
*Taylor, Edward H., Ph. D., 1928, assoc. prof. zoology, U. of K., Lawrence, Kan.
*Taylor, Mary Fidelia, A. M., 1930, asst. prof. household economics, K. S. C., Manhattan, Kan.
*Thompson, Charles J., M. S., 1931, science teacher, 931 Minnesota Ace., Kansas City, Kan.
*Thompson, D. Ruth, M. A., 1928, prof. chemistry, Sterling Col., Sterling, Kan.
Thurow, Mildred B., M. S., 1930, prof. home economics, McPherson Col., McPherson, Kan.
*Tissue, Kathryn Anne, M. S., 1929, Dept. Home Economics, U. of K., Lawrence, Kan.
*Tracy, Henry C., Ph. D. 1931, prof. anatomy, U. of K., Lawrence, Kan.
*Triplett, Dorothy, Ph. D., 1931, inst. psychology, K. S. C., Manhattan, Kan.
*Treece, E. Lee, Ph. D., 1929, assoc. prof. bacteriology, U. of K., Lawrence, Kan.
Truesdell, B. W., B. S., 1923, head Science Dept. H. S., Wichita, Kan.
*Tucker, Ruth E., M. S., 1928, instr. food economics and nutrition, K. S. C., Manhattan, Kan.
*Turney, Austin H., 1931. 331 Johnson St., R. 1, Lawrence, Kan.
*Wade, Joseph S., 1927, assoc. entomologist, U. S. Dept. Agric., Washington, D. C.
*Walker, George A., B. S., 1931, instr. anatomy, U. of K., Lawrence, Kan.
*Walker, M. V., 1929, Ft. Hays K. S. C., Hays, Kan.
*Walters, Orville, A. B., 1928, Physiology Dept., U. of K., Lawrence, Kan.
*Warren, Don C., Ph. D., 1925, prof. poultry husb., K. S. C., Manhattan, Kan.
*Wasinger, Sylvenus J., 1931, senior, Ft. Hays K. S. C., Hays, Kan.
Weatherly, Mrs. J., 1929, A. M., prof. psychology, K. S. T. C., Hays, Kan.
Webb, Frank A., 1930, research assoc., Bureau of Standards, National Lighting Co., Arkansas City, Kan.
Webb, Paul, 1930, research assoc., Bureau of Standards, National Lighting Co., Arkansas City, Kan.
*Weber, Clarence J., Ph. D., 1930, res. chemist, 4211 Booth St., Kansas City, Kan.
*Weber, Clement, Catholic priest, box 186, Selden, Kan.
*Weber, Louis R., Ph. D., 1928, head Physics Dept., Friends Univ., Wichita, Kan.
*Wedel, P. J., A. M., 1926, chemistry, Bethel Col., Newton, Kan.
*Weeks, Elvira, Ph. D., 1927, asst. prof. chemistry, U. of K., Lawrence, Kan.
*Weidlein, Edward Ray, Sc. D., 1911, director Mellon Inst. Industrial Research, Pittsburgh, Pa.
Wener, Henry, M. S., 1930, asst. prof chemistry, U. of K., Lawrence, Kan.
*Wheeler, Raymond H., Ph. D., 1930, head Psychology Dept., U. of K., Lawrence, Kan.
Whitcomb, S. L., A. M., Hon. Litt. D., 1926, prof. English, U. of K., Lawrence, Kan. (deceased).
*Wimmer, Edward J., Ph. D., 1928, asst. prof. zoology, K. S. C., Manhattan, Kan.
Woke, Paul A., 1930 senior Ottawa U., Ottawa, Kan.
*Wood, Robert E., M. S., 1930, chemistry, H. S., Lawrence, Kan.
*Woodward, Parke. M. D., 1930, asst. prof. physiology, U. of K.. Lawrence, Kan.
*Wooster, L. D., Ph. M., [illegible]

[illegible] McPherson Col., McPherson, Kan.
*Zinszer, Harvey A., Ph. D., 1930, prof. physics and astronomy, Ft. Hays K. S. C., Hays, Kan.
*Zinszer, Richard H., 1931, senior, Ft. Hays K. S. C., Hays, Kan.

SIXTY-THIRD ANNUAL MEETING
KANSAS ACADEMY OF SCIENCE

UNIVERSITY OF KANSAS

Lawrence, April 23-25, 1931

OFFICERS FOR 1930-31

Hazel E. Branch, Wichita	President
Roger C. Smith, Manhattan	First Vice President
Wm. H. Matthews, Pittsburg	Second Vice President
Ray Q. Brewster, Lawrence	Treasurer
George E. Johnson, Manhattan	Secretary

Chairmen of Sections

Mary T. Harman, Biology — George A. Dean, Entomology
Robert Taft, Chemistry-Physics — John C. Peterson, Psychology

Additional Members of the Executive Council

Wm. B. Wilson, Ottawa — Arthur W. Barton, Hays
Frank U. G. Agrelius, Emporia

PROGRAM

THURSDAY, APRIL 23

8:15 p. m. "The Grand Teton National Park and Jackson Hole, Wyoming", a lecture illustrated with colored lantern slides and motion pictures, by A. C. Lyon, guide.
Auditorium of Central Administration Bldg., third

FRIDAY, APRIL 24

9:00 a. m. Announcements and business. Marvin Hall, Room 206.

9:15 a. m. General papers. Marvin Hall, Room 206.

1:00 p. m. Exhibits and demonstrations, New Snow Hall, Room 220.
Sale of old volumes of Transactions, Frazer Hall, Tower.

1:30 p. m. Section programs:
- a. Biology, New Snow Hall, Room 101.
- b. Chemistry, Marvin Hall, Room 206.
- c. Physics, Marvin Hall, Room 210.
- d. Psychology, New Snow Hall, Room 206.
- e. Junior Academy of Science, New Snow Hall, R. 201.

5:45 p. m. Banquet at Cafeteria.
Address of Welcome. E. H. Lindley, Chancellor, University of Kansas.
Presidential Address: "Aims and opportunities of a Junior Academy of Science in Kansas." Hazel E. Branch, University of Wichita.

8:00 p. m. Address: "The work of the United States Bureau of Standards." George K. Burgess, Director, U. S. Bureau of Standards. (Under auspices of the University of Kansas Chapter of Sigma Xi.)

SATURDAY, APRIL 25

8:15 a. m. General papers and business. Marvin Hall, Room 206.
12:00 m. Meeting of new Executive Council.
1:30 p. m. Entomology papers. New Snow Hall, Room 417.

PAPERS SUBMITTED FOR THE SIXTY-THIRD ANNUAL MEETING

GENERAL PAPERS

Friday, April 24, 9:15 a. m., Marvin Hall, Room 206

1. Ammonia and chlorine in water treatment. Selma Gottlieb. U. of K. 10 min.
2. Wells flowing carbon dioxide. E. A. White, U. of K. 10 minutes.
3. Studies in the resistance of plants to insect attack:
   (a) Entomological phases. Reginald H. Painter, K. S. C. 12 minutes.
   (b) Agronomic and plant breeding phases. John H. Parker, K. S. C. 10 minutes.
4. Fossil grasses and other flora in western Kansas tertiary. M. K. Elias, U. of K. 10 minutes.
   (a) Synthetic atmospheres in relation to animal life.
   (b) How long animals can cease breathing and yet live.
   (c) The effects of partial pressures of pure oxygen upon animal life. J. W. Hershey, McPherson College. 10 minutes.
6. Methods of determining the relative humidity in small inclosed spaces. Roger C. Smith, K. S. C. 10 minutes.
7. Effects of alcohol on the reproductive power of the albino rat. Hazel E. Branch, U. of Wichita. 8 minutes.
8. New data on the production of eye defects in rabbits by means of lens antibodies. H. L. Ibsen and L. D. Bushnell, K. S. C. 15 minutes.
9. Centrioles in animals. W. J. Baumgartner. U. of K. 12 minutes. (See also demonstration 3.)
10. Bacterial association. Harold Zuber. U. of K. 12 minutes.
11. Early stages in the development of the rat ovum. Lennel I. Wright, U. of K. 10 minutes.
12. Symbiosis of bactera and animals. Johann Wiedman, U. of K. (Introduced by W. J. Baumgartner) 10 minutes.
13. The antigenic properties of the Escherichia coli, bacteriophage. A. Y. Wells, U. of K. (Introduced by W. J. Baumgartner.) 15 minutes.
14. A new stegoceph from the Pennsylvanian of Arkansas. H. H. Lane, U. of K. 5 minutes.
15. Volcanic ash deposits in Norton County, Kansas. G. L. Knight, U. of K. 10 minutes.
16. Unusual surface features of Kansas. Kenneth K. Landes, U. of K. 15 minutes.

BIOLOGY PAPERS

Friday, April 24, 1:30 p. m. New Snow Hall, Room 101

1. Germ cells in crows. Alfred Swan, U. of K. (Introduced by W. J. Baumgartner.) 10 minutes.
2. The centriole of the chicken. Maxwell J. Harris, U. of K. 15 minutes.
3. Studies on bursectomized and thymectomized chickens. Mary Woodward, K. S. C. (Introduced by E. J. Wimmer.) 7 minutes.
4. Scale anomalies associated with giantism in the lizard Eumeces fasciatus. Edward H. Taylor, U. of K. 7 minutes.
5. The growth of the head and trunk of the cat fetus. H. B. Latimer, U. of K. 15 minutes.
6. (a) Botanical notes, 1930.
   (b) The plants of Saline County by John Hancin.
   (c) The plants of Cloud County by S. V. Fraser. F. C. Gates, K. S. C. 15 minutes.

7. Botanical observations. Arthur W. Barton, Ft. Hays K. S C. 7 minutes.
8. Chromosomes of the Meadowvole Edith Beach, U. of K. 8 minutes.
9. Development of the urogenital sinus in the deer mouse. Geo. T. McNair, U. of K. 12 minutes.
10. A new method for the study of living germ cells of insects Miss Anthony Payne and W. J. Baumgartner, U. of K 5 minutes. (See also demonstration 2.)
11. Observations on the breeding of the guinea pig (Cavia cobaya). Mary T. Harman and Marjorie Prickett, K. S. C. 10 minutes.
12. (a) The development of the external form of the guinea pig between the ages of 11 days and 20 days of gestation.
(b) The fetal membranes of the guinea pig. Mary T. Harman and Marjorie Prickett, K. S. C. 15 minutes.
13. The effect of calcium and guanidine upon the irritability of the vagus nerves to the heart. R. A. Woodbury, U. of K. 13 minutes. (Introduced by O O. Stoland.)
14. Notes on fossil lagomorphs. M V. Walker, U. of K 10 minutes.
15. Chironomid egg masses, II. Hazel E. Branch, U. of Wichita. 7 minutes
16. Early life history of the thirteen-lined ground squirred. G. E. Johnson, K. S. C. 8 minutes.
17. Pituitary implants and reproduction cycle in the thirteen-lined ground squirrel. Mark A. Foster, K. S. C. (Introduced by G. E. Johnson.) 10 minutes.
18. The peripheral nervous system of the earthworm. B R. Coonfield, Southwestern College. 10 minutes.
19. The present status of certain mammals in western Kansas. L. D. Wooster, Fort Hays K S. C. 10 minutes.
20. Some observations on the parasites of the Annelida. Mary E. Larson, U. of K. 5 minutes. (See demonstration 1.)
21. A case of gigantism in Papulus grandidentata. W. C. Stevens, U. of K. 10min.
22. The sweet potato, stem or root? Mary Evelyn Hogue, U. of K. (Introduced by W. C. Stevens.) 10 minutes.
23. The biological anatomy of Triosteum perfoliatum. Esther Dempsey, U. of K. (Introduced by W. C. Stevens) 10 minutes.
24. Notes on a double headed calf. Hershel Gier, K. S. T. C., Pittsburg. (Introduced by O. P. Dellinger) 5 minutes
25. A key based on leaf characters of dicotyledonous plants, especially weeds of southwestern Kansas. Leland Gier, K. S. T. C., Pittsburg. (Introduced by O. P. Dellinger.) 5 minutes.

BIOLOGY DEMONSTRATIONS

Friday, April 24, 1:00 p. m. New Snow Hall, Room 220

1. Some observations on the parasites of the Annelida. (Microscope). Mary E. Larson, U. of K.
2. A new method for the study of living germ cells of insects. Miss Anthony Payne and W. J. Baumgartner, U. of K.
3. The centrosomes in a cricket and a duck. W. J. Baumgartner, U. of K.
4. Feeding punctures of the chinch bug in plant cells. R. H. Painter. K S C.

CHEMISTRY PAPERS

Friday, April 24, 1:30 p. m. Marvin Hall, Room 206

1. Isomeric di-substituted isothiohydantoins. Walter S. Long, Kansas Wesleyan. 7 minutes.
2. On the preparation of chemically stable and bacteriologically efficient hypochlorite solutions. Walter S. Long, Kansas Wesleyan. 8 minutes.
3. The chlorination of hydrocarbons. George W. Stratton. U of K. 10 minutes
4. (a) Some iodine derivatives of diphenyl ether. Ray Q. Brewster, U. of K 7 minutes.
(b) Iodine derivatives of carboxy-diphenyl ether. Franklin Strain and Ray Q. Brewster, U. of K. 8 minutes.
5. P. phenetidine and p. anisidine as oxidation indicators. Elvira Weeks, U. of K. 10 mnutes.
6. Effect of base held by and moisture content of soils on drift of pH as determined by the quinhydrone electrode. Alfred T. Perkins, K S. C. 10 minutes.
7. The hydrolysis of pectin. Henry Werner, U. of K. 10 minutes.
8. Natural gases of Kansas. H. C. Allen, U. of K. 10 minutes.
9. Testing Kansas-Oklahoma zinc ores by the electrolytic process. E. D. Kinney, U. of K. 10 minutes.

10. The action of bromine and iodine monochloride on some Schiff's bases. F. B. Dains and Glenn A. Lehmann, U. of K. 10 minutes.
11. Hydrogen ion concentration of the normal blood and of the blood after an animal dies. J. Willard Hershey, McPherson College. 5 minutes.
12. Glacial acetic acid as a lyophilic dispersion medium. Robert Taft and C. G. H. Johnson, U. of K. 10 minutes.
13. Solvents for gum arabic. II. Robert Taft and Lloyd Malm, U. of K. 5 minutes.
14. Theory of Leisegang ring formation. J. W. Hill, Tabor College. 10 minutes.
15. Properties of strontium-cadmium alloys. Harold C. Hodge, Ottawa Univ. 10 minutes.
16. Further study of reliability of examination grades in general chemistry. Harold C. Hodge and T. B. Homan, Ottawa Univ., 3 minutes.
17. Color record of qualitative analyses. Harold C. Hodge, Ottawa Univ. 3 min.
18. Project method in inorganic chemistry. Harold C. Hodge, Ottawa Univ. 3 min.
19. The determination of arginine in blood. C. J. Weber, U. of K. Med. Sch. 10 minutes.
20. Studies on the fermentation of xylose by Aspergillus flavus. H. N. Barham and B. L. Smits, K. S. C. 15 minutes.
21. Amphoterism in acetic acid solutions. A. W. Davidson and Ernest Griswold, U. of K. 10 minutes.
22. Some modifications of the periodic table. Jesse Stareck, U. of K. 15 minutes.
23. An apparatus for demonstrating the liquification of carbon dioxide. H. P. Cady and E. A. White, U. of K. 5 minutes.
24. Polarization in voltaic cells. H. P. Cady, U. of K. 10 minutes.
25. Methods of measuring surface tension of liquid ammonia solution. J. L. Hall and H. H. King, K. S. C. 10 minutes.
26. A theory of discontinuous electrolytic deposits. Robert Taft, U. of K. 10 min.

PHYSICS PAPERS

Friday, April 24, 1:30 p. m., Marvin Hall, Room 210

1. Investigation of resonance curves with respective to variation of capacity. Leo E. Hudiberg, K. S. C. 15 minutes.
2. A glass to metal joint. H. L. Knowles, U. of K. 5 minutes.
3. Dielectric constants of alcohol vapors. H. L. Knowles, U. of K. 10 minutes.
4. Several modes of vapor diffusion in condensed electric discharges. Harvey A. Zinszer, Ft. Hays K. S. C. 7 minutes.
5. Some special cases of Schwatt's method for summing series. Harvey A. Zinszer, Ft. Hays K. S. C. 8 minutes.
6. Possible effects of residual gas pressure upon E-M values for the electron. J. D. Stranathan, U. of K. 15 minutes.
7. Optical excitation of CdH and ZnH band spectra. Paul Bender, Hesston College. 15 minutes.
8. Effect of ionization upon air temperatures surrounding a hot body. C. V. Kent and Rex Davis, U. of K. 10 minutes.
9. Demonstrations of an inexpensive spectrometer and of a simple automatic mercury arc. C. V. Kent, U. of K. 5 minutes.
10. An electrostatic inductor alternator. E. R. Lyon, K. S. C. 15 minutes.
11. The spectral response of molybdenite in vacuo under the influence of heat. John H Fulton, Ft. Hays K. S. C 10 minutes.
12. The effect of shape of wave openings on the frequency of sperical resonaters. Ralph A. Shenk, K. S. C. (Introduced by E. V. Floyd.) 15 minutes.
13. Note on the three electrode gap as applied to instantaneous photography. Elgin A. Denio, Ft. Hays, K. S. C. 10 minutes.

PSYCHOLOGY PAPERS

Friday, April 24, 1:30 p. m. New Snow Hall, Room 206

1. Critical frequency relations in foveal vision. Harry R. DeSilva, U. of K. 15 minutes.
2. A student self-checking test device. J. A. Brownlee and John M. Michner, Wichita High School. 15 minutes.
3. Habit interference in relation to other factors in learning. O. W. Alm, K. S. C. 15 minutes.
4. The influence of degree of interpolated learning upon retroactive inhibition. John A. McGeoch, University of Missouri. 15 minutes.
5. The effect of entoptic activity of the injured or diseased retina upon the ma-

turation of sensory perception and imagination. Thomas D. Cutsforth, U. of K. 15 minutes.
6. The effect of incorrect guidance upon human maze learning. R. H. Waters, University of Arkansas. 15 minutes.
7. Some effects of the perception of figures on maze learning. Donald F. Showalter, U. of K. 15 minutes.
8. The relation between gestalt psychology and the behavioristic psychology at learning. Robert Leeper, University of Arkansas. 15 minutes.
9. A self-checking group experiment in rational learning. M. C. Moggie, K. S. C. 15 minutes
10. A personality schedule for use with adolescents. Edwina A Cowan, Friends U. 15 minutes.
11. Goal activity in the white rat. Robert L. Brigden, U. of K. 15 minutes.
12. The role of muscular tensions in stylus maze learning. J. B. Stroud, K. S. T. C., Emporia. 15 minutes.
13. Visual acuity as a function of intensity. Warren Wilcox, U. of K. 15 minutes.
14. An experimental study of rythm. Byron Sarvis, U. of K. 15 minutes.

JUNIOR ACADEMY OF SCIENCE PROGRAM

Friday, April 24, 1:30 p. m. New Snow Hall, Room 201

Chairman, Prof. N. H. Rudie, Hays High School

Music: String Quartet of Lawrence High School.

1. How the Junior Academy began. Geo. E. Johnson, K. S. C.
2. The Illinois Junior Academy Frank C. Gates, K. S. C.
3. Aims and opportunities of a Junior Academy in Kansas. Hazel E. Branch. University of Wichita.
4. Reports by student representatives from various high schools.
   Eugene Richardson, Lawrence Junior High School.
   Floyd Teas, Manhattan High School, "A simple photo-electric cell and its construction."
   Delegate from Wichita High School East.
   Billy Fields. Ben Franklin Club. Lawrence High School.
   Leon Amberg and Wm. Bowersox. Glasco.
   Walter Varnum, Lawrence "Radio making."
5. General discussion of desirability and possibilities of the Junior Academy.
6. Consideration of methods of organization and a possible constitution by high school delegates and teachers, including the chairman and other members of the committee on the Junior Academy (W. D. Royer, Wichita, and E. C Almquist, Hutchinson.)

The following science teachers have declared their intention of attending this meeting: L. P. Elliott, Manhattan High School; John Brownlee and J. W. E. Stogsdill, Wichita High School, East; Nettie Wismer and Edith Beach, Lawrence Junior High School; Robert E. Wood, Lawrence Senior High School.

GENERAL PAPERS AND BUSINESS

Saturday, April 25, 8:15 a. m. Marvin Hall, Room 206

1. Medical aptitude tests and selection of medical students. O. O. Stoland, U. of K. 15 minutes.
2. Mottled enamel, a dental defect and its occurrence in Kansas. R. W. Kehr. U. of K. 15 minutes.
3. The effect of anterior pituitary implants on hibernation. Geo. E. Johnson, K. S. C. 7 minutes.
4. The diurnal variation in hemoglobin in man. C. F. Nelson and Ruth Stoker. U. of K. 15 minutes.
5. A new poisonous forage plant in Kansas pastures L. L. Boughton, U. of K. 10 minutes.
6. A check list of plant diseases and fungi of Egypt. L. E. Melchers, K. S. C. 15 minutes.
7. Glacial striae and grooves in Kansas. W. H. Schoewe, U. of K. 10 minutes.
8. An X-ray induced change in the inheritance of grouse locust color patterns. Robert K. Nabours, K. S. C. 7 minutes.
9. Field work contrasted with laboratory work. L. C. Wooster, K. S. T. C., Emporia. 10 minutes.
10. Data on the fecundity and vocational and educational status of 350 married women graduates of the University of Kansas. Florence B. Sherbon, U. of K. 5 minutes.
11. Scientists and scientific investigation in Soviet Russia. P. L. Gainey, K. S C 10 minutes.
12. Spectral hue as a function of intensity. Donald McLean Purdy, U. of K. 15 minutes.

PAPERS TO BE READ BY TITLE

1. The pictographs of Ashley and Dry Fork Valleys in northeastern Utah. Albert B. Reagan, Ouray, Utah.
2. Some values of continuous guidance in reading and thinking. J. C. Peterson, K. S. C.
3. F. F. Crevecoeur, a versatile Kansas naturalist. R. C Smith, K. S. C.

ENTOMOLOGY PAPERS

Saturday, April 25, 1:30 p. m. New Snow Hall, Room 417

1. A record of a new family of insects for Kansas. R. H. Painter, K. S. C.
2. Recent work with Haitain Neuroptera and Canadian Chrysopidae. Roger C. Smith, K. S. C.
3. The chinch bug as a rice pest. Dwight Isley, University of Arkansas.
4. The Knaus Collection. W. Knaus, McPherson
5. Hydrometra types (Hydrometridae-Hemiptera in European museums. H. B. Hungerford, U. of K.
6. The biology of Mesovelia douglasensis Hung. (mesoveli dae Hemiptera. C. H. Hoffman, U. of K.
7. Resistance of sorghum varieties to chinch bug injury. R. O. Snelling, K. S. C.
8. Mill fumigation with a new form of hydrocyanic acid gas (discoids). Geo B. Wagner K. S. C
9. Notes in regard to the arbor-vitae aphis, Dilachnus tujafilinus Del Guer. R. L. Parker, K. S. C.
10. Collecting trip in Florida. R. H Beamer, U. of K
11. Tree distribution of codling moth. P. M. Gilmer, Wichita.

Minutes of the Sixty-third Annual Meeting

A meeting of the executive council was called to order by the president, Dr. Hazel E. Branch, at 8:15 a. m., April 24, 1931, in New Snow Hall. Some changes in constitution and by-laws relating chiefly to organization of the sections were presented by the secretary for consideration. These were approved, with some modifications, for submission to the Academy.

The sixty-third annual meeting of the Academy was called to order in Room 206, Marvin Hall, at 9:15 a. m., April 24, 1931, by Dr. Hazel E. Branch, president. The following committees were appointed:

Resolutions: Sternberg, Hershey, Crow, Nabours.
Necrology: R. C. Smith, White, Harnly.
Auditing: Havenhill, Coofineld.
Program: L. D. Wooster, Agrelius.
Nominations: Kester, Schoewe, McKinley.

A revision of section seven of the constitution and of by-laws I, V and VII and of the proposed new by-laws X, XI, XII were read in order that they might be voted on the following day.

After announcements and a word of welcome from Chancellor E. H. Lindley of the University, the program was given as printed with only slight exceptions.

A meeting of the executive council was held at 9:15 p. m., April 24, 1931, in the Auditorium of the Administration Building. Opinion was somewhat divided as to limitation of sectional meetings to Friday afternoon of the usual day and a half session. Some members suggested that when the section programs were too long the Saturday forenoon program begin with a general program followed by the business meeting and end with about one or two hours of section program. It was decided that the new by-law XII provided the elasticity needed in case more time should be needed for the section program at some future meeting. Invitations for the 1932 meeting were received from McPherson and Wichita. It was decided that these be presented at the business meeting on April 25. It was moved that the council recommend to the Academy that the secretary's railroad expenses incurred while serving as Academy representative at the Council of the American Association for the Advancement of Science be remitted. A substitute motion recommending that all expenses be paid was approved.

The regular business meeting of the Academy was called to order by the president at 9:00 a. m., April 25, in Room 206, Marvin Hall The following report of the secretary was read and accepted:

REPORT OF THE SECRETARY AND EDITOR

Publication: Nine hundred fifty copies of Volume 33 of the Transactions were printed and delivered in February, 1931, by the Kimball Printing Company, Manhattan, at the rate of $2.60 a page. Two hundred reprints of each paper were made at 50c a page. The Academy delivered 250 copies of the Transactions to the Kansas State College, 125 to the Ft Hays State College, and 200 to the University of Kansas as per agreement (Transactions 32:21) These three institutions have divided the Academy library in a manner agreeable to all three and have paid or arranged to pay their first of ten annual payments to the Academy in 1931 for Volume 33 of the Transactions, and for exchange services as per agreement on page 21 of Volume 32 of the Transactions.

Membership: To date, April 25, 1931, 67 new members have joined the Academy. Arranged by cities and institutions they are:

Atchison (H. S.): Rex H. A. Davis, Homer A. Stephens.
Atchison (St. Benedict's Col.) Oskar K. Burger.
Aurora: S. V. Fraser.
Baldwin (Baker U.): Clara Hartley.
Eldorado (Jr Col.): E. G. Dick.
Emporia (College of Emporia): F. T. Owen, D. C. Schaffner, H. M Spiker.
Emporia (K.S.T.C.): Elma V. Cooke, Roy H. Downs, Agnes R. Hibbs, Lelan K LeMaster, Anna M. McCullough, Elma L. Mullings.
Hays (Ft. Hays K. S. C.): Julius R. Bahl, Fred V. Dellett, Elgin A. Denio, John Eichman, Henry Foreman, John H. Fulton, Warren E. Portenier, Sylvenus T. Wasinger, Richard H. Zinszer.
Hesston (Hesston College): Paul Bender.
Hillsboro (Tabor College): A. Clement Eitzen, J. W. Hill, S. L. Loewen.
Iola (Iola Junior College): J. B. Bruce
Kansas City, Kansas: Charles J. Thompson.
Kansas City, Missouri: A. J. Griner.
Lawrence (U. of K): Edith Beach, Robert L. Brigden, Maud A. Brown, Thomas D. Cutsforth, Maxim K Elias, Selma Gottlieb, Maxwell Harris, R. U. Kehr, H. L. Knowles, Geo. T. McNair, Arthur J. Mix, U. G. Mitchell Finlay Munro, James Naismith, D. McL. Purdy, F. C. Sauer, Florence Sherbon, M. B. Soderberg, Geo. W. Stratton, Henry C. Tracy, Austin H. Turner, Geo. A. Walker.

Lindsborg (Bethany College): Arthur W. Nelson.
Manhattan (K. S. C.): O. W. Alm, Rodney W. Babcock, Harold N. Barham, Louise A. Everhardy, Robert A Evers, Arthur L. Goodrich, Jr., Leo E. Hudiberg, Richard R. Marsh, Ruth McCammon, Martha S Pittman, Dorothy Triplett.
Ottawa (Ottawa U.): Harold C. Hodge.
Pittsburg (K. S. T. C.): O. W. Chapman, W. B. Parks, Mary E. Renich.
Stockton (H. S.): Ralph H. Imler.
Wichita: J. C. Brown.
Wichita (Friends U.): Glenn A. Lehmann.
Wichita (U. of Wichita): J. F. Dunn, Jr., E. A. Martin, Kenneth F. McClure.
Winfield (Southwestern Col.): John L. Figley.

Library Members:—Harvard University Library (1930); Kansas City, (Mo.) Public Library (1930). Oregon State College (Corvallis) (1930).

Vol. 33 of the Transactions shows 176 annual members (125 old, 51 new) had paid their dues by the time of the annual meeting, and 49 more paid dues in 1930. At the date of this meeting 233 members (135 old, 77 new) have paid dues for 1931, or 57 more than last year. At the end of last year we had 225 paid up annual memberships. At the same rate we should have about 270 paid up memberships for 1931, or a total of about 335 memberships of all classes. In 1930 we had 53 life members and 13 honorary members, or a total membership in good standing of 291 In 1929 out total membership was 281, and in 1928 it was 253, at the time the Transactions were published.

GEORGE E. JOHNSON, Secretary.

The following report was read by the treasurer and accepted:

TREASURER'S REPORT

RECEIPTS

Balance on hand May 1, 1930	$ 850.52
Dues from members	35?.50
Recieved from A. A. A. S	71.50
Sale of reprints to members	134.97
Sale of Transactions to Kansas State College	200.00
Sale of Transactions to University of Kansas	200.00
Sale of Indices and Reprints to Kansas State College	14.00
Miscellaneous Sales of Transactions	19.00
Interest from certificates of Deposit	22.49
	$1878.98

DISBURSEMENTS

Kimball Printing Company	$ 692.76
President Hazel E. Branch (circular letter)	4.25
Miscellaneous bills paid by secretary	152.34
Postage (treasurer's office)	1.00
Total disbursements	$850.36
Balance on hand	$1028 62
	$1878.98

RAY Q. BREWSTER, Treasurer.

The report of the treasurer was declared to be correct by the auditing committee.

The committee on resolutions presented the following resolutions:

1. That we express our appreciation to Chancellor E. H. Lindley, Dr. W. J. Baumgartner, Dr. Robert Taft, Dr. R. H. Wheeler, Dean Geo. Shaad, Dr. Edward H. Taylor, and other members of the faculty of the University of Kansas for the hospitality extended to the Kansas Academy of Science during the 63rd annual meeting.

2. That we express our sincere appreciation to the officers of the Academy, especially to Dr. Branch and Dr. Johnson, and to the University of Kansas Chapter of Sigma Xi for the splendid entertainment and excellent arrangements during the meeting.

3. That we extend our cordial appreciation to Dr. George K. Burgess, Director of the U. S. Bureau of Standards for his inspiring and very instructive address.

4. That we also express our appreciation to the Central Scientific Company, Chicago; the Griner Company of Kansas City, and to various microscope companies for their exhibits.

5. That the Academy send greetings to E. H. S. Bailey and to George H. Failyer.

6. That we heartily support President Branch, Secretary Johnson, and others in their efforts to encourage the establishment of the Junior Academy.

R. K. NABOURS
J. WILLARD HERSHEY, Chairman.

The representative of the Academy on the Council of the A. A.A. S. submitted the following report:

Your representative attended the Academy Conference December 29, 1930, at Cleveland, Ohio, and also the daily meetings of the Council of the A. A. A. S. at the 1930-31 session. The Academy Conference is a meeting of the representatives of the various state academies of science with the secretary and two other representatives of the A. A. A. S. Its purpose is to promote the welfare of the Academies by exchange of ideas.

Three papers were presented. The first one was on acdemay libraries by E. C. L. Miller of the Virginia Academy. Apparently slightly less than half of the sixteen academies he had heard from had libraries of some size. He presented no reason why an academy should have a library but stated that the accumulation of books made it necessary to give them space and attention. Most academies have deposited their books with a state, a university, or a museum library. There was considerable discussion of the points in the paper, including the present Kansas Academy plan.

The second paper was on Science Clubs in Tennessee by John T. McGill of the Tennessee Academy. It was suggested that science clubs might be affiliated with the state academy just as the academies are affiliated with the American Association for the Advancement of Science. He suggested that the Academy could help organize new clubs in different places, arrange conference meetings of club groups, provide for public lectures to stimulate community interest in the work of the science club, and make the academy publications useful to the clubs.

The third paper was the Junior Academy of Science movement in Illinois by Miss Alta McAvoy of Rockford, Illinois. She stated that the Junior Academy was intended to help develop creative power of boys and girls. They have a separate program at the academy meetings with addresses by the best scientists, iniaiation ceremonies, talks by the students and visits to industries. Displays of projects are set up and indvidual and group prizes awarded. They are trying to develop a Junior Academy Club in every high school. These clubs have meetings, with a science lecture a year in assembly. They have a pep book of songs and poems, give prizes for summaries of material in scientific magazines and hold a "science week" each year. Each club sends delegates and its sponsor to the Junior Academy section of the state academy. The discussion following the paper indicated that this movement has stimulated the scientific interests of high school students and that the movement will probably spread to other states.

GEORGE E. JOHNSON.

Dr. R. C. Smith presented the recommendation of the council that all the expenses of the secretary incurred while serving as representative of the Academy to the Council meetings of the A. A. A. at Cleveland, Ohio, in 1930-31 be remitted. This was approved.

The necrology committee submitted the following report, which was accepted.

The committee finds that the following members of the Kansas Academy of Science have died during the year: Ephriam Miller, F. F. Crevecoeur, and George T. McNair. Biographical accounts of these men are given in this report, excepting that of F. F. Crevecoeur, which is published as a paper in this volume. Since no obituarial account of J. E. Todd, who died several years ago, has yet been published in the Transactions, the committee is including this obituary in this report.

EPHRIAM MILLER, 1833-1930

Ephriam Miller, professor emeritus of mathematics at the University of Kansas, died at Pasadena, California, November 21, 1930.

Professor Miller was a member of the University of Kansas faculty for 36 years; was the University librarian for 13 of these years and dean of the College of Liberal Arts for eight years. He was made professor emeritus of mathematics and astronomy June 3, 1910. He was named assistant in mathematics in June, 1874, and made professor of mathematics the year following.

He was University librarian from the fall of 1874 until 1887, and was dean of the College from 1895 to 1903. He was on leave of absence in 1904 to complete work on his doctorate.

Professor Miller was born in a log cabin April 25, 1833, near Carrollton, Ohio. Before he was fifteen years of age he was teaching a district school. A neighbor gave him a scholrship at Allegheny College, from which he received an A. B. degree in 1855 and M. A. in 1858. He was superintendent of schools in Youngstown, Ohio, in 1855-56, and of Findlay, Ohio, 1859-70. He came to the University of Kansas from Findlay.

He was one of the founders of the society of the Sigma Xi at the University of Kansas, and a member also of Phi Beta Kappa and of the Kansas Academy of Science. He was a contributor of papers on mathematics and astronomy to the programs of the latter society, and was the author of "Plane and Spherical Trigonometry".

GEORGE T. McNAIR, 1891-1931

Dr. George T. McNair, assistant professor in the department of zoology, died April 18, 1931, at the Lawrence Memorial hospital after a short illness following a heart attack. He came to the University in the fall of 1925, and had been teaching and doing research work here since. During the summer months he had worked on embryological research, writing several articles for the Biological Bulletin announcing the results of his work.

Dr. McNair was born October 5, 1891, in Rawlins, Wyoming. He went to elementary and high school in Bedford, Iowa, and later entered Coe College at Cedar Rapids, where he received his B. S. degree in 1915. Dr. McNair did graduate work at the University of Chicago, where he was granted his M. S. degree in 1921. He also took graduate work at the Iowa Lakeside Biological laboratory at Lake Okoboji, and at the Marine Biological laboratory at Woods Hole, Mass. He received his Ph. D. from the University of Kansas in 1930.

Since 1915 Dr. McNair had been either teaching or studying zoology throughout the entire year. He began teaaching in the Cedar Rapids High School. Later in 1921-22, he taught at Carlton College Northfield, Minn., and then he taught at the Oklahoma College for Women at Chickasha, Oklahoma, until he came to Kansas.

Doctor McNair was a member of the American Association for the Advancement of Science, the Ecological Society of America and the American Society of Mammalogists. He had listed a paper on the program of the Kansas Academy of Science for the Lawrence meeting, 1931.

JAMES EDWARD TODD, 1846-1822

James Edward Todd, assistant professor in the department of geology, died at his home, Lawrence, Kansas, October 29, 1922. Professor Todd was one of the oldest members of the faculty of Kansas University, having been born February 11, 1846, in Clarksville, Ohio, and coming to the University in 1907. For the last four years of his life he was not able to give full time to his work, although his interest in the University remained unflagging. After his graduation from Oberlin College n 1867, he took his Master's degree from the same institution in 1870. He served during the Civil War in Company K, 150th Ohio Infantry. Professor Todd was one of the thousand starred men of science and the author of many articles on geological subjects. He was a member of the Geological Society of America, Sigma Xi, and the Kansas Academy of Science and the American Association for the Advancement of Science.

JAMES ARTHUR HARRIS (1880-1930)

Dr. J. Arthur Harris, Professor and Head of the Department of Botany in the University of Minnesota, passed away. on April 24 1930, after a brief illness. He was an honorary member of the Kansas Academy of Science. This account is taken from a more detailed one published by the Journal of American Statistical Association, September, 1930.

Born in Plantsville, Ohio, on September 29, 1880, he came as a boy to Kansas. At the age of twenty-one he took his A. B. degree at the University of Kansas and had to his credit four worthy publications. It became his desire to help place Biology alongside of Physics and Chemistry in the ranks of the so-designated "exact" sciences.

He was assistant botanist at the Missouri Botanical Gardens in 1901-03. During that time he completed the requirements for his A. M. degree at Kansas University (1902), and in 1903 received the degree of Doctor of Philisophy at Washington University. He was librarian at the Missouri Botanical Garden from 1904 to 1907, when he became botanical investigator for the Station for Experimental Evolution of the Carnegie Institution at Cold Spring Harbor. In 1903-07 he combined an instructorship in general biology at Washington University with his other work.

An admirer of Karl Pearson and of exact methods he availed himself of an opportunity to carry on his studies in the Galton Laboratory in 1908-09. In 1921 he received the Weldon Medal and Weldon Memorial Prize from the University of Oxford In 1924 he was called to the post he held at the time of his death

Although professionally a botanist, the whole field of biology was his realm for the application of the statistical method. A student of ecology, his greatest interest always centered in the plant or organism living in its natural surroundings. As a biometrician he intuitively grasped the philosophy of mathematical thought. He translated mathematical equations into simpler forms that were more readily comprehensibile to biologists. To him the gift of great intellectual power meant but a greater obligation in service. His own thirty years of endeavor in science are only part recorded in his three hundred papers. His wide interests and genuinely tolerant attitude made it easy to discuss with him things which in most circles would be matters of controversy.

He was married to Miss Emma Lay of New York on April 10, 1910. His devotion to his home was exemplary. He is survived by his wife and four boys.

E. A. WHITE
H. J. HARNLY
ROGER C. SMITH, Chairman

The new chairmen of sections, who would be ex-officio members of the executive council, were announced as follows:

Biology: W. J. Baumgartner, U. of K.
Chemistry: W. S. Long, Salina Wesleyan.
Physics: E. V. Floyd, K. S. C.
Psychology: R. H. Wheeler, U. of K.
Junior Academy: Hazel E. Branch, U. of Wichita.
Entomology (announced later): R. H. Beamer, U. of K.

The committee on nominations, through its chairman, F. E. Kester, presented the following nominations: President, Roger C. Smith, first vice president, W. J. Baumgartner; second vice president, J. W. Hershey; treasurer, Ray Q. Brewster; secretary, Geo. E. Johnson; additional members of the executive council, Hazel E. Branch (retiring president), Robert Taft, J. A. G. Shirk. By motion the nominees were elected by unanimous vote.

Invitations for the 1932 meeting were received from Wichita and McPherson. Upon motion it was decided to meet in McPherson.

Dr. W. C. Stevens, who joined the Academy in 1890, was elected to life membership.

By motion it was approved that the Academy purchase an addressing machine.

Retiring-president Branch called president-elect Smith to the chair.

Upon motion of Dr. Branch it was approved that the secretary be allowed to draw upon the treasurer for $100 for stenographic work.

Upon motion by Dr. Baumgartner it was voted that a committee of three be appointed to investigate the coordination of scientific groups in Kansas and to report back to the Academy in 1932.

Upon motion by Dr. Baumgartner it was voted to appoint a committee of two or three to interview the legislature in regard to state aid for the Academy.

Upon motion by the secretary it was voted that the following committees be appointed:

Endowment and Investments (treasurer to be chairman).
Junior Academy of Science.
Natural History Survey and Ecology.

The following appointments were made by president-elect Smith:

Publications: Gates, editor-in-chief, Peterson, Rankin, Zinzer, Johnson.

Investments and Endowments: Brewster, Havenhill, Johnson.

Natural History: Schoewe, E. H. Taylor, Knaus.

Junior Academy: Branch, Hershey, and three high school teachers to be appointed.

Coordination of Scientific Groups: Taft, Harman, Landes.

State Aid: Baumgartner and two others.

Membership: Wheeler, J. L. Hall, Barton, Wright, Breukelman, Johnson.

GEORGE E. JOHNSON, Secretary.

PAPERS AND ABSTRACTS

SIXTY-THIRD ANNUAL MEETING, LAWRENCE, 1931

THE AIMS AND OPPORTUNITIES OF THE JUNIOR ACADEMY IN KANSAS*

HAZEL ELISABETH BRANCH
University of Wichita, Wichita, Kansas

At the sixty-second annual meeting of the Kansas Academy of Science held at Hays, April 18-19, Dr. Geo. E. Johnson, secretary, gave his report as a delegate to the American Association for the Advancement of Science, December 1929, at Des Moines, Iowa. In this report we find a recommendation for the appointment of a committee, of interested high school teachers to study the matter and take such steps, as seem advisable to them and to the executive council of the Academy, for the fostering of Science Clubs in various high schools and colleges of the state; and in the building up of a program given by representatives of these clubs as a sectional meeting of the Academy.

Such a committee was appointed: Mr. N. H. Rudie of Hays High School as chairman, Mr. W. D. Royer of Wichita High School East and Mr. E. C. Almquist of the High School at Hutchinson.

A circular letter in March was feebly responded to and a second letter was sent out in April. These letters have resulted in the program held this afternoon.

At this meeting thirty students and ten adults (including the president and secretary of the Senior Academy) were present. The following program was given.

Music—String Quartet of the Benjamin Franklin Club, Lawrence
History of the Junior Academy ---------------- Dr. Geo. E. Johnson
The Junior Academy of Illinois ------------------ Dr. F. C. Gates
The Aims and Purposes of a Junior Academy -- Dr. Hazel E. Branch
Collecting Insects—Eugene Richardson, Lawrence Junior High School
A Photo-electric Cell—Floyd Teas, Manhattan High School

Impromptu talks were made by Walter Varnum of Lawrence High School on "Radio Making", and by Billy Fields on the "Work of the Benjamin Franklin Club of Lawrence High School.

*Presidential address delivered April 24, 1931.

After the program, a simple, working constitution was adopted and the following Junior Academy officers elected: Eugene Richardson, 326 Illinois St., Lawrence, president; Margaret Kelsall of Lawrence, vice president; Eugene Perry of Manhattan, secretary-treasurer.

After discussions and suggestions relative to the forming of Science Clubs, the meeting adjourned to meet next year with the Senior Academy.

A few statistics as to our own resources in human material in Kansas might be in point here.

In 11 cities of the first class:			
27 Junior High Schools	16,019		
15 Senior High Schools	13,039		
Total			29,058
In 76 cities of the second class:			
50 Junior High Schools	33,270		
67 Senior High Schools	20,521		
Total			53,791
3 not of A grade		775	
In cities of the third class:			
569 High Schools			39,841
446 not of A grade		23,760	
Total 728 schools			122,690
Total 279 Grade A schools			98,155

There are 42 private schools for which no enrollment could be ascertained in the state educational directory; eight private Junior Colleges; ten public Junior Colleges.

When we think of this for our own state and learn that there are over six millions of students in high school, public and private, in the United States at this time, we realize that there is plenty of material for our work, all that the material lacks is the directing power to form a nation wide movement in Junior Academy projects.

The Illinois State Academy of Science is the parent of this movement and to date they have 35 affiliated High School Clubs, 14 of which were added in this last year. At their last meeting there were 175 students present at the junior meeting and they presented 130 projects. Illinois started by striving for teacher interest with only feeble results, but at their 1928 meeting they started the method of a

High School Section with high school students presenting projects in which they were interested. With this interest came the affiliation of the college science clubs so that these students, when they became teachers, would be better able to direct the students in the junior groups.

Numbers of states have taken up the work started in Illinois and these to date are: Alabama, Indiana, Iowa, Kansas, Kentucky, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas and West Virginia. New Hampshire and Virginia are considering the movement this spring.

The detailed work of organization is great. The pupils must learn of this opportunity to meet together, to report their projects, perhaps to have some of them appear in print in our transactions or in some organ for that work. Pupils of this age will not work for the sheer love of the accomplishments and it will be our privilege to supply the stimulus. The Junior Academy will be the central agency and the High School Science Clubs will be where the real work will be done. The over-worked teacher will be loath to add to the already very heavy load, but let the student call and the teacher will rally and be glad to be of a service so much out of the ordinary.

We, as a Senior Academy, must enact by-laws governing such an organization, the Junior Academy must have its own Constitution and by-laws, and for the sake of the appeal there must be ceremonial rituals, pins, certificates of membership, contests, awards and all the other things which go to make an organization attractive to persons of the high school age.

Tonight we celebrate our 63rd year as an Academy in this state and as our fathers in science pioneered here in the days past, so must we pioneer in this new field.

Edison has said that there will be more discoveries in the next forty years than in the past four hundred. This seems to be a well nigh impossible task when you do a small problem in subtraction and find yourself at the year 1531. Before Vesalius overthrew the reign of authority in which the anatomists, at least, were following a text of Galen written thirteen centuries earlier and translated through five different languages during the Dark and Medieval Ages and based originally more on dog than human structure; before Harvey discovered the circulation of the blood, when men believed that the blood surged from the heart and returned to the heart in the same vessels much as we expel and suck up a fluid in a pipette; long before Hooke saw the tiny partitions in cork and theorized that tissues were made up of infinitely small but definite parts; before Leeuwenhoek perfected the lens and saw protozoa and bacteria; before

Edward Jenner discovered vaccination as a preventive against smallpox; before Louis Pasteur discovered the microbe as the causative organism in infectious diseases; before Simpson discovered anesthetics; or Franklin, electricity.

When we commence to list the discoveries even within our own days we are appalled. We have all seen the development of the airplane from its first struggles to conquer the forces of the air to transcontinental, and perhaps we should include transoceanic, successes. Many others of us can remember when the automobile was not and have seen that project come from the horseless carriage to the eight cylinder of eighty miles an hour, and there are a few among us who possibly remember in their early childhood, the pony express and the mail coach. History is in the making and we are a part of it, monarchies are falling, governments are reorganizing, the old conditions are breaking everywhere, the whole sphere of education is turning and we must turn with it or fall off into space.

If Edison's prophecy is to come to pass then some mighty power must be stirring, these young generations must be more dynamic than ours has been. And how may this be brought about? The answer is apparent. We must help them to be mentally productive earlier in life.

The cry for longer life in man, that he may be able to exercise the fruits of his education for a longer period of time and add to the wealth of civilization, seems to have been answered when preventive medicine shows that in the last two decades the life expectancy of man has been extended from 49 to 58 years. But this does not really mean that man as an individual may live any longer. Preventive medicine has decreased infant mortality and raised the average. Plagues have been diminished and wholesale death no longer occurs, but man continues to live out his three score and ten quite regularly.

If we may not lengthen life, then we must educate for earlier productiveness in order to give the longer time for development. To do this we must begin specific training earlier, no doubt at the price of many of the cultural subjects, but progress destroys many things which it finds in its path. We must place more of our training in the high school not only because these are the earlier years, but because this is where the next generation really is. It is not in our colleges and universities.

If we take the official statements from Washington, we find that out of 100 pupils who start to school, only 13 remain to graduate from the eighth grade and that only 70 per cent of these go into high school. Statistics also show that only 50 per cent of those who

graduate from the eighth grade, graduate from high school and only 5 per cent of these go to college and only 2 per cent of these graduate from college. This leaves us with the balance on the side of the high school for our field of endeavor.

We are all familiar with the old phrase that our sons should not expect to begin where we leave off, but surely if science is to progress they should not begin where we began, they should be one step in advance, to say the least.

Wiggam suggests in his "Religion of the Scientist", that we train in the spirit and the method of science, for it is through these that the discoveries will be made. And this is in accord with the statements of Dr. Millikan, who pleads more for method and broadness of mind than fact. He says that five-eighths of our conclusions will be changed in the next ten years as new evidences are discovered and he reads backward as Edison reads forward and says: "We have discovered more in the last 10 years than in the previous 20, and more in that 20 than in the previous 100, and more in that 100 than in the previous 2000."

In the light of this perhaps the prophecy of Thomas Edison is not too impossible, but we are filled with an awe when we realize our responsibilities—that of equipping a generation to accept this challenge.

Concretely then we must do something to put the generation into the field of productive thinking at an earlier age and this means giving the student his fundamentals of science in high school rather than in college. We could do more with our college student if he came to us with his first ten hours of any given science accomplished and if when he did come with some of it we could carry him forward from that point, not ask him to repeat with a group that knows not the alphabet of science. Some of us are loath to entrust the teaching of fundamentals to the high school and there was a time when this criticism might have been just, but now that the standards of the whole educational system are higher and high schools are demanding the Master's degree and colleges are demanding the Ph. D. degree where a few years ago the Bachelor's degree and the Master's degree respectively were sufficient, it seems that the time has come for the placing of this elementary work in the high school. This is exactly in accord with the trend in all walks of life.

But what of the student himself? We cannot say to him, do this or do that, it will be good for you. He too has been changing and he no longer does as he is told just because he is told, he needs to wish to do before he can accomplish anything.

This is the realm of the Junior Academy: "To give him an incentive to do this thing." Here are the meetings at which he will meet others like himself. Here he will find those who are interested in the same things in which he is interested. It will give him the urge to get his specific training earlier; to give to the world the best of his youth.

And here a new idea breaks through to us, that this is in accord with our ideals of true internationalism. That these boys and girls will grow up with the spirit which we have had to learn, i. e., that science knows no political boundaries; that all nations and races are working toward the same end: the education of the masses in the ways of scientific thought, that through understanding all misunderstanding will pass away.

This is our opportunity. Come! Let us forward and upward with the Junior Academy as our watchword, let us join hands with other states and other lands across the seas and make a place for the younger generation in this rising tide of science.

FIELD WORK VS. LABORATORY WORK

LYMAN C. WOOSTER
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The Kansas Academy of Science was organized at Topeka in 1868 as the Kansas Society of Natural History with Professor B. F. Mudge as its first president. Science was young at that time in Kansas and the members of the new society began at once the collection of data to be used in building a scientific knowledge of the state.

Professor Mudge made the collection of fossils his chief work; Doctor F. H. Snow began his magnificent collection of insects and by 1905 he had gathered 170,000 specimens belonging to 21,000 species; Professor J. H. Carruth took up the study of plants of Kansas; Professor F. W. Cragin and Miss Annie E. Mozeley made reports on reptiles of the state; Colonel N. S. Goss took for himself the study of the birds of Kansas and other regions; and Professor J. T. Lovewell gathered data in chemistry and on the weather conditions.

Professor E. A. Popenoe helped in the study of insects and Professors W. A. Kellerman Frank U. G. Agrelius continued the . study of plants The latter had in 1931 about 4,000 specimens and 1,000 species. Doctor S. W. Williston started in the work of simplifying our classification of flies and then took up his work on Kansas fossil vertebrates. Warren Knaus began the study of Coleoptera in 1880 and since 1883 has made annual reports of progress till 1930. In 1905 Mr. Knaus reported having collected 5,512 species of beetles and in 1931 about 10,000 species and 75,000 specimens, with 25 new species and one new genus—all the latter named Knaus.

Professor A. S. Hitchcock and Mr. B. B. Smyth reported from time to time on their studies of the plants of Kansas. Mr. Smyth in 1905 reported having collected 5,600 specimens belonging to 1860 species. Professors Sayre and Bailey made many reports on the practical side of chemistry in which they were joined by Doctor Willard; Mr. J. R. Mead contributed many facts from his experience as a pioneer in Kansas; Doctor J. M. MacWharf added much in the way of health suggestions. Professor L. L. Dyche will be remembered for his work in natural history and especially for his fine collection of mounted mammals.

The Kansas Society of Natural History soon became the Kansas Academy of Science and its members turned away more and more from field work and took up studies in laboratories and libraries, possibly of equal value but not so suggestive nor so attractive.

Among those who have continued the work in natural history are Professor L. D. Wooster in western Kansas, who is pushing his

studies in animal ecology in the field, and Mr. Elam Bartholomew, who has become the leading authority on fungi in the United States, perhaps in the whole world. Papers describing field work in geology have been presented at nearly every meeting of the Academy. The more persistent of these amateur geologists have been Professors B. F. Mudge, Robert Hay, J. E. Todd, E. Haworth, W. H. Schoewe, J. A. Yates and L. C. Wooster. The last named has collected 400 species of fossils with many duplicates and several new species.

The writer has not attempted the impossible task of naming in this paper all who have added valuable data to the store of knowledge gathered by the members of this Academy. Rather, he has mentioned a few of our members and their special fields of work to indicate, imperfectly to be sure, the value of this society to science in Kansas. One great incentive to the members in their labors was the hope that they were helping the schools and colleges to a better knowledge of the resources of their state. With this in mind many of the members of the Academy stored their collections in museums expecting that the students of the schools would profit by what had been so enjoyed in the collecting. Lacking the collecting spirit the students merely looked on the collections with idle curiosity.

Why did the collector value his collection? Why did Doctor Horn of Berlin pay Doctor Snow of Lawrence $30 for two tiger beetles? Why is a poorly printed postage stamp issued by Hawaii in an early day listed at $3,500? Why are old coins and ancient furniture valued so highly?? Why should an English lady spend her time and money in collecting 20,000 buttons, all different? This interest is so intense that teachers would better try to understand it if they would hold their pupils to their school work.

Psychologists tell us that one of the most powerful urges in man and to a less degreee in the lower animals is the one that causes the individual to try to gain eminence among his fellows. He likes better grades, he labors in season and out to get more buttons than any one else, he spends months and years in getting a larger and more complete collection of beetles than any other collector, he would be supremely happy if he could fill his stamp album with 20,000 stamps, and, strangely enough, the longer he works on his collection the more he loves it.

In reality it is not his collection the collector prizes so highly but his own preeminence, his own worth. Sometimes he lives long enough to discover this truth. The writer heard Dr. John M. Coulter of the University of Chicago, tell his class in botany that his collection of plants, one of the largest in the United States, was worth no more than so much hay. He had found that only a few of his

specimens were valuable for illustration purposes in his lectures. For the same reason the writer would say that museums, with very few exceptions, are not worth the space they occupy in a high school or college building. Museums to be at all valuable in education must be explained by a skilled attendant and never be used as a loafing place.

Occasionally the collection shares with the collector the glory of its existence and just as the miser handles fondly his gold coins so the collector handles with deep pleasure his rare specimens.

Many scientists have found the making of collections of plants, animals and biologic truth all so interesting that they have filled text books and manuals with specific accounts of their discoveries. In the kindness of their hearts, to say nothing of their own glory, they have expected high school and college boys and girls to go into the laboratories and pretend to find all these good and wise things by themselves with the aid of the text-books and instructors. But unfortunately this did not work out as they hoped. The students showed a lack of interest in many ways for they lacked back-ground and foreground for this kind of work. They did not possess the powerful incentive to labor which the hope of discovering something new to science has given to those who have labored months and even years in a single line of research in their own laboratories.

A few of the ways in which students in high school and college show their lack of interest in class laboratory work are the following:

1. The time in the laboratory is wasted in play or on side issues.

2. I have seen half of the class of an eminent Yale professor disappear from the laboratory before the end of the hour.

3. Students are asked to rediscover what they already know.

4. The class is not under close supervision by the assistants.

5. The lecture and laboratory work do not cover the same ground.

6. There is much waste of material and apparatus.

7. There is no natural sequence in the work in the laboratory from day to day and therefore the students lose interest.

8. The investigations are seldom completed.

9. Students may have more interest in companionship than in work.

10. Students copy the results of others in the laboratory.

11. Notes are frequently copied from the notebooks of other students.

12. Students cannot find in their dissection what the text-book pictures show. Text pictures are the results of months and even years of study.

13. Students have little experience in the work of classification.

14. The student dwells such a brief time on even important phases of his work in laboratory and lecture room that such slight impression is made on the surface cells of his brain that it fades out in an equally brief time. It may be renewed for final examination purposes, after which it is lost until chance use renews it.

The writer would not be understood as saying that observations in museums of the mounted skins of birds and mammals, of the skeletons of animals, and of the shells and corals of marine life, are without educational value, nor that the work by students in well conducted laboratories is useless. Neither would the writer like to say that the tracing of plants and animals thru complicated keys to find their names is without value to the student; but he would say that the value of all this mechanical work has been greatly exaggerated.

Biology, as its name implies, is a study of living plants and animals and not dead ones. A knowledge of how plants and animals behave in the plains, valleys and mountains in their struggles for existence is many times what is gained by a study of anatomy and morphology to learn where an organ belongs in a scheme of classification.

Names for plants and animals are necessary, of course, but these can be learned by children, even, from colored pictures on charts, or from books with colored plates and brief descriptions. Let those, alone, who hunt for new or unfamiliar species of plants and animals learn the three or four hundred descriptive terms used in Gray's Manual or in Britton & Brown; or the thousand and one names of parts described in any comparative anatomy like Wiedersheim or Parker & Haswell's Textbook of Zoology.

The highly mathematical phases of physics and chemistry lend themselves more completely to laboratory work than do the thought phases and we therefore find that real educational work in these subjects may be done at the chemistry and physics tables, but more interesting work can be done by using the lecture-laboratory method of conducting recitations in all scientific subjects. This is the writer's experience in thought physics, chemistry and biology.

In closing this paper the writer would commend the Burgess Nature books for Children, published by Little, Brown & Company on Birds, Animals and Flowers.

Summary—Lines of collecting or lines of investigation to be interesting must be continued long enough to arouse in the student feelings of superiority over others engaged in similar work. The

urge for preeminence grows with months and years of exercisee in one line of collecting or thinking—it is feeble if exercised for only a few hours or days.

Field work is vastly more interesting than class laboratory work and to the same extent is more effective as an educational force. The collections made in field work deposited in museums and the books filled with the results of personal investigations are of small importance to others. Therefore, museums filled with collections and books filled with names, facts and generalizations are of little worth to students in high schools and colleges unless both are vitalized by wise instructors. The lecture-laboratory method of conducting recitations in which student preparation, lecture by the instructor and simple experiments or observation or simple dissection of specimens are combined in immediate and interrelated succession have reached excellent results at the hands of many teachers.

THE PROJECT METHOD IN ADVANCED INORGANIC CHEMISTRY

HAROLD CARPENTER HODGE
Ottawa University, Ottawa, Kansas

Abstract

The course in advanced inorganic chemistry varies greatly, in subject matter as well as in purpose, in the various universities and colleges. A number of important objectives can be realized by study of advanced inorganic, among which should be listed a thorough review of general chemistry, a study of the descriptive chemistry of the common and rare elements in greater detail than can be gained in general chemistry, and an organization of the properties of the elements and their compounds to render the information available.

Study of the periodic table introduced the course, following which each member of the class selected one of the several forms of the three dimensional periodic table and actually carried out the reproduction of his choice. The construction of the table proceeded simultaneously with a description of the properties of the elements and their compounds by groups of the periodic table, using as a text B. Smith Hopkins' book, "Chemistry of the Rarer Elements". The study of the properties included methods of separation, purification, identification, and the important properties of the compounds chiefly from the standpoint of usefulness. Because of the attention to detail necessitated by the construction of the models of the tables, this study presented a means of close connection of group similarities and individual elemental differences.

THE PROPERTIES OF STRONTIUM-CADMIUM ALLOYS

HAROLD CARPENTER HODGE
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Abstract

The preparation of alloys of strontium-cadmium up to twenty-five per cent strontium is described. A tentative thermal diagram is offered, based on microscopic and thermal data. The current efficiency, Shore scleroscope, Brinell, and Rockwell hardness data, and the specific gravity of the alloys are recorded.

FURTHER STUDIES OF THE RELIABILITY OF EXAMINATION MARKS IN GENERAL CHEMISTRY

T. B. HOMAN AND HAROLD CARPENTER HODGE
Ottawa University, Ottawa, Kansas

Abstract

In a preliminary study, the median paper from a first mid-term examination in General Chemistry was mimeographed, questions and answer, and sent to one hundred college and university professors of General Chemistry. Sixty-four instructors returned graded lists. The grades given ranged from twenty-two per cent to fifty-seven per cent with an even distribution between these marks.

It was believed that the essay type of examination had been responsible for the variation in grades awarded. An objective type examination, therefore, was devised and submitted as well as a mid-term examination. The median paper was submitted as before to one hundred instructors in General Chemistry. To date thirty-seven instructors have returned graded lists. The highest mark is seventy-five, the lowest twenty-eight, with an even distribution of grades between.

THE COLOR RECORD OF QUALITATIVE ANALYSIS IN THE LABORATORY

HAROLD CARPENTER HODGE
Ottawa University, Ottawa, Kansas

Abstract

The use of color charts as a means of recording the results of qualitative analysis has been reported[1] and adopted by several of the more recent texts[2] in elementary qualitative analysis. Using the color method of recording, the student draws a progressive representation of the actual operations of the laboratory as he performs them, noting (a) the reagents used, (b) the processes, such as filtration carried out, and (c) at the same time coloring his diagram by means of colored crayons the actual colors observed in his test tube or flask. This record serves a dual purpose; first, of leaving a continuous and up to date statement of his own progress, and second, at the same time recording the most important physical property of the compounds he deals with. It has been found that by numbering the procedures serially and placing correspondingly numbered labels on the flasks containing the substances in operation, the difficulties due to confusion of materials in various parts of the systematic analysis have been largely obviated.

1. Hodge, Jour. Chem. Educ., 4, 242-4.

2. (a) Scott, W. W., 1928. Elements of Qualitative Chemical Analysis, D. Van Nostrand Co., Inc., New York.

(b) Miller, F. W., 1930 A Laboratory Manual of Qualitative Analysis. The Century Co., New York.

UNUSUAL SURFACE FEATURES OF KANSAS

KENNETH K. LANDES

Abstract

This paper is limited to a few of the most striking surface features in western Kansas. These originate through (1) the activity of underground water (2) the activity of surface agents of erosion, mainly running water, and (3) a combination of both underground water activity and surface erosion. The first group is illustrated by (a) Coolidge sink, formed through the falling in of the roof of a cavern which in turn was formed through the dissolution of soluble rock by ground water, (b) Big Basin (Clark county) a much larger and older depression but probably of similar origin, and (c) the natural bridge in Barber county, formed through the falling in of the roof above the ends of a gypsum cave which was being used as a water course.

Erosion may be subdivided into those carved from sandstone and those carved from chalk. The small buttes and toadstool rocks of Hell's Half Acre (Comanche county) illustrate the former. Examples of the latter are Castle Rock, Chalk Bluffs, and the Monument Rocks and Sphinx, all in the upper Smoky Hill River valley.

The large spheroidal rocks of Rock City (Ottawa county) are formed through a combination of ground water activity and surface erosion. Cementation by ground water first formed hard nearly cylindrical concretions in the Dakota sandstone and these were isolated from the surrounding incoherent sandstone by differential

A CHECK LIST OF PLANT DISEASES AND FUNGI OCCURRING IN EGYPT

LEO EDW. MELCHERS

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FOREWORD

There is an old Latin proverb which says, "there is always something new coming out of Africa." Certainly this is and has been true of Egypt for many centuries and applies to plant life as well as to the discovery of monuments left by the Pharaohs.

The collection of fungi made in Egypt in the beginning of the nineteenth century is an example, since recent records show these yielded many new species. Fungi were collected in Egypt as early as 1820. Schweinfurth et al. spent several years in Egypt, collecting plants, including fungi, and as far as the writer knows, this was the first systematic collection in that country. Undoubtedly this scientist had the encouragement of Mohammed Ali, then King of Egypt, who is known as the Father of modern Egypt. He was known to have financed scientific expeditions and encouraged new agricultural pursuits.

Mention of the early collections is found in numerous publications, among them a recent contribution, Die Pilzflora Aegyptens, by Israel Reichert; Verlag von Wilhelm Engelmann, Leipzig, 1921. Unfortunately, none of these fungi was retained in Egypt or, if they were, there is no record of their preservation. The specimens are in the mycological herbarium of the Botanisches Museum, Dahlem, Germany. Reichert used this Egyptian collection for compiling the list in the aforementioned publication. In working over the material he describes 42 new species.

In 1927, the writer went to Egypt at the invitation of the Egyptian Minister of Agriculture as Chief Mycologist for a period of one and one-half years. Part of his work consisted of a plant disease survey of the crops district of Egypt. Difficulties were encountered, in that no mycological herbarium was available and no collection of Egyptian fungi had been made recently. It is extremely unfortunate that Britton Jones and T. Fahmy did not attempt to make a collection of fungi to support their publications on the mycological notes of Egypt from 1920-1923. Even more regrettable is the fact that no records are available on the occurrence, distribution, or dates when their mycological observations in Egypt were made. As a result, at the time the writer was in Egypt, no definite information was available on the distribution or occurrence of fungi or, the use of a mycological herbarium.

It was apparent that a card record system of the occurrence and distribution of fungi in Egypt was imperative. In as far as possible, therefore, all the literature which might have any reference to the occurrence of Egyptian fungi was consulted. The records in the literature, however, are incomplete and in many instances the date, place of collection, or collector's name is omitted. The information available, however, from this source has been compiled as accurately as possible. Those fungi were added to this list which the writer and his associates collected during the years 1927 to 1929. The collections and records obtained by the author show that 88 heretofore unreported fungi and plant diseases occur in Egypt and of these, three are apparently due to new species of fungi.

In the plant disease survey which was conducted (1927-1929), all information pertaining to the collection or occurrence of fungous, virus, and non-parasitic diseases in Egypt were brought together in host and organism indices. The data from these records, together with the records compiled from the literature, have been assembled in this paper in alphabetical lists, giving the organism, host, place of collection, date and collector's name. A list of non-parasitic diseases, virus, mosaic, and eelworm maladies has been included.

In following this plan it is believed the list of parasitic and non-parasitic plant diseases of Egypt, is as complete as possible under existing conditions and should be useful in scientific investigation in Egypt and other countries. It is realized that some omissions by the writer may occur, and no claim is made for completeness, but these lists will prepare a way for a new one which may be made in the future, to which any omissions and new findings may be added.

In closing this foreword the writer presents the following lines:

"In Nature's infinite book of Secrecy,
A little I can read."—Antho and Cleopatra.

ACKNOWLEDGMENTS

The author desires to thank the Kansas State Board of Regents and Pres. F. D. Farrell, of the Kansas State Agricultural College for the extended leave of absence, during which this work was accomplished.

He also wishes to express his deep appreciation of the support given him by the Egyptian Ministry of Agriculture, Cairo, Egypt. The Higher Egyptian Officials did everything possible to support the work financially and morally and it was a pleasure to serve as their Chief Mycologist for a period of one and one-half years.

The writer is greatly indebted to Dr. Monir Bahgat and Dr. A. B. Sirag-el-Din for their help in collecting specimens and accompanying the writer on many of the survey trips. Youkim Farag Eff, also aided in this work. Dr. Sirag-el-Din determined many of the species. Wherever "L.E.M. et al." is mentioned as having made the collection, it has reference to the writer and one or more of these men. The writer wishes to gratefully acknowledge the kindness and assistance given him by these workers without which this study would have been impossible.

After returning to the United States about 70 specimens were sent to Ross W. Davidson of the Office of Mycology and Disease Survey, Bureau of Plant Industry, U. S. D. A. He very kindly examined the collections, identified some of them and verified the determinations of the remainder, which was of great help to the author. Miss Edith Cash of the same office assumed the responsibility of checking the authorities of the organisms listed herein and the writer is very grateful to her for this help.

Miss Nellie Jacobs of the Department of Botany and Plant Pathology, K. S. A. C., gave much valuable assistance in checking the authorities of the host plants in the preparation of the manuscript, and Miss Elsa Horn kindly made the three illustrations.

INTRODUCTORY NOTE

It is the purpose of this paper to bring all the records of the occurrence of non-parasitic fungi and plant diseases in Egypt together into one list.

It will be noted that the collector's name of some of the species in the accompanying list is not given. These represent the early collections of the nineteenth century by Schweinfurth et al. and it is not possible to tell with certainty from Reichert's publication, "Die Pilzflora Aegyptens", who the collector is. However. those species are in the herbarium of the Botanisches Museum, Dahlem, Germany, and complete data are no doubt available. In many instances the date and place of collection in the accompanying list are necessarily omitted because the information is not available.

The reports of Britton Jones, 1920-22, and of T. Fahmy, 1923, are not accompanied by the specific place of occurrence or the time of year. The writer compiled what information he could from their publications. The dates of their reports as given in this article, therefore, do not represent the actual dates of occurence of plant diseases, but the date of the authors' publications. These investigators did not collect any specimens, therefore, no records of the actual dates, distribution, etc., are available.

In the plant disease survey and collection trips in 1927-1929 by the writer and assistants, mycological specimens were collected and these were accompanied by the necessary records of date and place of collection. The specimens were identified and later these determinations were verified. One complete set of specimens collected in 1927-1929 has been deposited in the Mycological herbarium at Giza, Egypt, one is in the office of Mycology and Plant Disease Survey, Washington, D. C. (U. S. A.), and one in the mycological herbarium of the Department of Botany and Plant Pathology of the Kansas Agricultural Experiment Station, Manhattan, Kansas, U. S. A.

The abbreviations for the names of the collectors or the individual who reported the occurrence of the disease as used in this paper are as follows:

M. B.=Monir Bahgat

T. F.=Tewfik Fahmy

Y. F.=Yoakim Farag

B. J.=Britton Jones

L.E.M. et al.=L. E. Melchers and others

R. M. N.=R. M. Nattrass

Schwein.=G. Schweinfurth

A. S. el N.=A. Seif-el-Nasr

A. B. S. el D.=A. B. Sirag-el-Din

The writer wishes especially to call attention to the arrangement of the subject matter. Pages 45 to 75 are arranged on the basis of the organism-host scheme, while pages 76 to 90 are the reverse order, namely, the host-organism presentation. This makes it possible to determine the occurrence of a plant disease in Egypt either from the organism or the host point of view. Pages 91 to 106 are devoted to Plant Diseases other than Fungous or Bacterial.

A CHECK LIST OF PLANT DISEASES AND FUNGI OCCURRING IN EGYPT[1]

LEO EDW. MELCHERS

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ORGANISM-HOST ARRANGEMENT

Actinonema rosea (Lib.) Fr. (See Diplocarpon rosae (Lib.) Wolf.)	
On Rosa sp.	Egypt, 1920-22. B. J.
On Rosa sp.	Meadi, May 10, 1928. M. B.
Aecidium euphorbiae Schw.= Uromyces proeminens (DC.) Pass.	
On Euphorbia punctata Delile	Hatieh Oases, Egyptian-Syrian Desert 1881. (?).
Agaricus campestris L.	
	Egypt, 1835.
	Egypt, 1920-22. B. J.
Albugo candida (Pers.) O. Kunze	
On Brassica napus Linn.	Damietta, Mar., 1877.
On Brassica nigra Koch	Cairo, Mar., 1877.
On Coronopus niloticus Spreng.	between Alexandria and Cairo, 1820-25.
On Diplotaxis harra Boiss.	Mokattam Hills, May 2, 1908.
On Malcolmia aegyptiaca Spreng.	Sakkara, May 3, 1908.
On Nasturtium sp.	Beni-Suef, May 3, 1908.
On Reseda pruinosa Delile	Alexandria, date ?.
On Sisymbrium irio Linn.	Damietta, May 2, 1908.
Albugo tragopogonis (DC.) S.F. Gray	
On Reichardia picroides Roth	Alexandria, date ?.
Alternaria brassicae (Berk.) Sacc.	
On Brassica campestris Linn.	Egypt, 1920-22. B. J.
Alternaria citri N. B. Pierce	
On Citrus sp.	Egypt, 1920-22. B. J.
On Citrus sp.	Egypt, 1923. T. F.

1. Contribution: From the Mycological Division of the Egyptian Ministry of Agriculture, Cairo, Egypt, and contribution No. 315, Department of Botany and Plant Pathology, Kansas Agricultural Experiment Station, Manhattan, Kansas, U. S. A.

Alternaria solani (E. & M.) Jones and Grout
On Lycopersicum esculentum Mill. — Egypt, 1920-22. B. J.

Alternaria sp.
On Citrus aurantifolia Sw. — Damanhour, Sept. 15, 1928. L. E. M. et al.
On Citrus sp. leaves — Egypt, 1930. H. S. Fawcett.

Armillaria mellea Vahl.
On Populus spp. — Egypt, 1920-22. B. J.

Aspergillus candidus Link
On Opuntia ficus-indica Mill. — Bulak, date ?.

Aspergillus flavus Link
On Saccharum officinarum Linn. — Egypt, 1923. T. F.[1] (Erroneous report)

Aspergillus phoenicis (Cda.) Lindau
On fruit of Phoenix dactylifera Linn. Alexandria, 1837.
On fruit of Phoenix dactylifera Linn. Large Oases, Dec., 1901.(?)
On ripe fruit of Phoenix dactylifera Linn. — Cairo, Dec., 1901.

Bacillus mangiferae Doidge
On Mangifera indica Linn. — Egypt, 1920-22. B. J. (Probably erroneously reported)

Bacillus solanacearum EFS.
On Solanum tuberosum Linn. — Egypt, 1920-22. B. J. (Probably erroneously reported)

Bacterium malvacearum EFS.
On Gossypium sp. — Egypt, 1920-22. B. J.
On Gossypium sp. — Mit Dafer, Oct. 31, 1927, L.E.M. et al.
On Gossypium sp. — Egypt, 1928, L.E.M. et al.

Bacterium marginale Brown, N.
On Andropogon sorghum Brot. — Cairo, Jan. 1927, L. E. M. et al.

Bacterium phaseoli EFS.= Pseudomonas phaseoli EFS.
On Phaseolus vulgaris Linn. — Egypt, 1923. T. F.

Bacterium tumefaciens EFS.= Pseudemonas tumefaciens EFS. & Towns.
On Diospyros sp. — Egypt, 1924-25.
On Malus sp. (apple) — Egypt, 1924-25.
On Malus sp. (apple) — Barrage, Nov. 20, 1928. L.E.M. et al.
On Prunus sp. (plum) — Egypt, 1924-25.

Battareopsis artini P. Henn.
Under asphalt paving of a villa. — Alexandia, Dec., 1901.

1. In a leaflet by the Egyptian Ministry of Agriculture. List of Fungous, Bacterial and Physiologic Diseases, 1923, by T. Fahmy. This organism is erroneously reported as the cause of mosaic.

Battarea phalloides (Dicks.) Pers.=	
Lycoperdon phalloides Dicks.	Nile bridge across from Cairo, Dec. 1880.
Bispora hamonis (Ehrenb.) I. Reichert	
On Phoenix dactylifera Linn.	Near Bir Haie, Dec. 1822-25.
On dry stems of Phragmites communis Trin. v. isiaca (Del.) Cosson	Bir Haie, Nov., 1822-25.
On leaves of Salicornia fruticosa Linn.	Cairo, Mar., 1822-25.
Bispora opuntiicola I. Reichert	
On Opuntia ficus-indica Mill.	Alexandria, Jan. 1922-25.
Boletus bovinus L.	
Soil of Zoological garden.	Giza, Dec. 12, 1901.
Boletus subtomentosus L.	
Garden in Giza.	Near Cairo, Feb., 1890.
In Zoological Garden	Cairo west, Jan., 1912.
Botrytis cinerea Pers.	
On Allium cepa Linn.	In markets, Hamburg, Germany, 1900.
Botrytis sp.	
On Gelsemium sp.	Alexandria, July 9, 1928. M. B.
On Vitis sp. (grape)	Assuit, July 9, 1928. M. B.
On Vitis sp. (grape)	Abu-el-Shekuk, July 9, 1928. M. B.
Brachysporium flexuosum (Cda.) Sacc.	
On Panicum crus-galli Linn.	Alexandria, Nov., 1877.
Bremia lactucae Regel	
On Lactuca sativa Linn.	Wadi Rissched, May, 1893.
On Lactuca sativa Linn.	Egypt, 1920-22. B. J.
On Lactuca sativa Linn.	Egypt, 1923. T. F.
On leaves of Launaea nudicaulis Hook.	Heluan, May 3, 1893.
Capnodium citricolum McAlp.	
On Citrus sp.	Egypt, 1920-22. B. J.
Cephalothecium roseum Cda.	
On Carica papaya	Giza laboratory, 1930, H. S. Fawcett
Cercospora apii Fr.	
On Apium graveolens Linn.	Egypt, 1920-22. B. J.
On Apium graveolens Linn.	Giza, Oct. 16, 1927. Y. F.
Cercospora beticola Sacc.	
On Beta vulgaris Linn.	Egypt, 1920-22. B. J.
On Beta vulgaris Linn.	Egypt, 1923. T. F.
Cercospora (? musarum) Ashby "Black-tip".	
On Musa sp.	Alexandria, Jan., 1928. L.E.M. et al.
On Musa sp.	Giza, Dec. 1, 1928. L.E.M. et al.
Cercospora personata (B. & C.) Ell. & Ev.	

On Arachis hypogaea Linn. ------- Bilbe's, Oct. 27, 1927. L.E.M. et al.
Cercospora roesleri (Cattan.) Sacc.
On leaves of Vitis vinifera Linn. -- Alexandria (Ramleh), Nov. 22, 1911.
Cercospora rosicola Passer.
On Rosa gallica Linn. ------------ Cairo, date ?.
On Rosa gallica Linn. ------------ West Cairo, date ?.
Cercospora snelliana I. Reichert
On leaves of Morus alba Linn. ---- Bahtim, near Kahiram, Nov., 1913.
Cercospora violae Sacc.
On leaves of Viola odorata Linn. -- Delta Barrage, date ?.
On leaves of Viola sp. ----------- Egypt, 1923. T. F.
Cercospora viticola (Ces.) Sacc.
On Vitis vinifera Linn. --------- Egypt, 1920-22. B. J.
Cercospora sp.
On Anethum graveolens Linn. ---- Birket-el-Sab, Dec. 10, 1928. Y. F.
On Corchorus olitorius Linn. (Meloukia) ---------------------- Tanta, Nov. 13, 1927. L.E.M. et al.
On Salix sp. ------------------- El Hawaber, Oct. 15,1928. L.E.M.et al.
Ceriomyces fici Pat.
Darb-el-Gamamiez near Cairo, 1901.?
Cerotelium fici (Cast.) Arth.
On Ficus sp. (fig) -------------- Alexandria, Dec. 22, 1927. L.E.M. et al.
On Ficus sp. (fig) -------------- Giza, Hort. Farm, Oct. 18, 1928. L. E. M. et al.
On Ficus sp. (fig) -------------- Sidi Garber, Dec. 21, 1928. L. E. M. et al.
Cicinnobolus cesatii DeBary
In Oidium erysiphoides Fr.
On Linum usitatissimum Linn. --- Fayoum, April, 1879.
In Oidium on Vicia calcarata Desf. Fayoum, Mar., 1899(?).
Cintractia algeriensis Pat.
On inflorescence of Danthonia forskalii Trin. ------------------ Sandhills Rosetta, July, 1880.
Cladosporium acaciae I. Reichert
On Acacia farnesiana Willd. ------ Rhoda and Kahiram, Feb., 1822-25.
Cladosporium fulvum Cke.
On Lycopersicum esculentum Mill.- Giza, Dec., 1927. L.E.M. et al.
On Lycopersicum esculentum Mill.- Mansura, Oct. 31, 1927. L.E.M. et al.
Cladosporium gramineum Corda
On leaves of Andropogon foveolatus Delile ------------------ El Tor, date ?.
Cladosporium herbarum (Pers.) Link.
On Astragalus fruticosus Forsk. -- Rosetta, 1901 (?).
On Triticum sp. ---------------- Lower Egypt, 1920-22. B. J.
On capsules of Zilla spinosa Th. Dur. & Schinz. --------------- Wadi Dugla near Cairo, 1901 (?).

Cladosporium hibisci I. Reichert
On Hibiscus esculentus Linn. ----- Assuit, Oct., 1922-25.
Cladisporium pyriformum I. Reichert
On Opuntia ficus-indica Mill. ------ Bulak, 1822-25.
Cladosporium typharum Desm.
On leaves of Typha angustifolia Linn. ------------------------ Gabbaris near Alexandria, date ?.
On leaves of Typha latifolia Linn. - Wadi-el-Natrun, date ?.
Cladosporium sp.
On Hordeum vulgare Linn. ------ Abu Hommos, Jan. 4, 1929. L.E.M.et al
Clasterosporium lindavianum I. Reichert
On Phoenix dactylifera Linn. ----- Kahiram, 1822-25.
On Phragmites communis Trin. v. isiaca (Del.) Cosson ---------- Mansura, 1822-25.
Clathrococcum magnusianum I. Reichert
On leaves of Euphorbia prunifolia Jacq. ------------------------ Salamum near Mansura, date ?
Clitocybe mairii I. Reichert
Kafr Daouar, Jan. 12, 1909.
Clitocybe mellea (Vahl) A. Ricken
In Zoological garden ------------- Giza, Dec. 20, 1901.
In Zoological garden ------------- West Cairo, Dec., 1911.
Colletotrichum gloeosporioides Penz.
On Citrus trees ----------------- Egypt prior to 1913.
On Citrus trees ----------------- All over Egypt, 1920-22. B. J.
On Citrus trees ----------------- Egypt, 1923. T. F.
On Citrus trees ----------------- All over Egypt, 1927. L.E.M. & M. M.
On Citrus trees ----------------- All over Egypt, 1928. L.E.M. & M. B.
On Citrus trees ----------------- All over Egypt, 1929. L. E. M. & M. B.
On Citrus (orange) twigs -------- Egypt, 1930. H. S. Fawcett.
On Mangifera indica Linn. ------- Egypt, 1928. T. F.
Concibulum vulgare (Erroneous rept.)
Egypt, 1920-22. B. J.[1]
Coniothecium heterosporum I. Reich.
On Phoenix dactylifera Linn. ----- Bir Haie, Nov., 1822-25.
On foliage of Thymelaea hirsuta Endl. ------------------------ Bir Hamam, Dec. 1822-25.
Coniothecium tamariscinum Thuem.
On twigs of Tamarix mannifera Ehrenb. Wadi Giaffara near Bilbeis, June, 1880.
Coniothyrium diedickeanum I. Reich.
On Anabasis articulata Moq. ------ Kahiram, Nov. 1820-25.
Coniothyrium sporoboli I. Reichert
On Sporobolus spicatus Kunth ---- In desert at Heluan, Dec., 1905.

1. No such fungus. Perhaps B. Jones had in mind Crucibulum vulgare Tul.

Coprinus atramentarius (Bull.) Fr.	
In gardens ----------------------	Cairo (Shubra), Dec. 17, 1901.
	Egypt, 1920-22. B. J.
Coprinus barbeyi Kalchbr.	
In sand manured with camel dung.	Egyptian-Arabian Desert near the Oasis Aisoum Monca, 1882 (?).
In sand manured with camel dung.	Egyptian-Syrian desert near Bir Abou Rouk and Bir-el-Abid. 1882(?).
	Cairo, 1901 (?).
Coprinus clavatus Fr.	
	Rosetta, date ?.
Coprinus clavatus Fr. v. **arenosa** Roumeg.	
In sands and watered gardens ----	Cairo, Nov. 6 and Dec. 8, 1886.
Coprinus comatus Fr.	
In low moist soil ----------------	Shirbin (Gharbieh), Nov. 21, 1909.
Coprinus comatus Fr. v. **barbeyi** Roumeg.	
	Wadi Aschar (Galala), Apr., 1887.
	Egypt, 1920-22. B. J.
Coprinus disseminatus (Pers.) A. Ricken	
In sand filter beds --------------	Cairo, date (?).
Coprinus jasmundianus Kalchbr.	
In regions of Dakhla oasis. ------	Pass Babl-el-Callend and Babl-el Jasmund, Mar., 1874.
Coprinus micaceus (Bull.) Fr.	
Base of trees in gardens. --------	Alexandria and in old Cairo, Feb. 1890
In manured gardens. ------------	Luxor, 1902(?).
In Zoological Gardens. -----------	West Cairo, Jan. 13, 1912.
Coprinus sterquilinus Fr.	
In gardens of Grand Hotel. -------	Luxor, Mar. 9, 1902.
Corticium vagum Berk. & Curt.	
On Gossypium sp. ---------------	Egypt, 1923. T. F.
Corticium sp.	
On Verbena sp. ------------------	Egypt, 1923. T. F.
Coryneum sp. (**beijerinckii?**) Linn.	
On fruit of Prunus armeniaca Linn.	Cairo, 1929. L. E. M.[1]
Cyathus stercoreus (Schwein.) De Toni=**Nidularia stercorea** Schwein.	
On decayed twigs of Gossypium sp.	Shirbin, Oct. 25, 1909.
Cystopus portulacae (DC.) Lev.	
On Portulaca oleracea Linn. ------	Egypt, 1920-22. B. J.
On Portulaca oleracea Linn. ------	Mansura, Oct. 31, 1927. L.E.M. et al.

1. Found on fruit shipped into Egypt.

Darluca filum (Bivon.) Cast.
In uredosori on Cynodon dactylon Pers. ---------- San, Mar., 1822-25.
In uredosori of Uromyces striatus Schr. on Medicago ciliaris Krock Damietta, Dec., 1911.
In uredosori of Puccinia rottboelliae on Rottboellia compressa Linn. v. fasciculata Hack. ---------- Farasun Delta, Dec., 1911.

Dictyophora phalloidea Desvaux
Salkia near Quatyeh and El Arish, date ?.

Didymosphaeria epidermidis (Fr.) Fuck. ----------
On dry stems of some dicot (undetermined.) ---------- Bir Kres, Sept., 1822-25.

Diplocarpon rosae (Lib.) Wolf
On Rosa spp. ---------- Gharbieh, 1927. L.E.M. et al.
On Rosa spp. ---------- Meadi, May 10, 1928. M. B.

Diplodia opuntiae Sacc.
On Opuntia ficus-indica Mill. ---------- Bulak, 1822-25.

Diplodia warburgiana I. Reichert
On Citrus medica Linn. ---------- Cairo (Rhoda), Feb., 1822-25.

Diplodia sp.
On Phoenix dactylifera Linn. ---------- Egypt, 1930. H. S. Fawcett.
On Mangifera indica Linn. (twigs) - Egypt, 1930. H. S. Fawcett.

Diplodia donacina (Sacc.) Allescher
On dry stems of Phragmites communis Trin. v. isiaca (Del.) Cosson Cairo, Feb., 1822-25.

Entyloma schweinfurthii P. Henn.
On leaves of Polypogon monspeliensis Desf. ---------- Giza pyramids, Mar., 1902.

Epicoccum sp.
On Mangifera indica Linn. (leaves) Egypt, 1930. H. S. Fawcett.

Erysiphe cichoracearum DC.
On Citrullus vulgaris Schrad. ---------- Egypt, 1924-25.
On Cucumis sativus Linn. ---------- Giza, Jan., 1928. L. E. M. et al.
On Cucumis sativus Linn. ---------- Barrage, May 11, 1928. L.E.M. et al.
On Cucurbita laginaria Linn. ---------- Egypt, 1920-22. B. J.
On Cucurbita laginaria Linn. ---------- Giza, Alexandria, 1928. L.E.M. et al.
On Cucurbita pepo-condensa (oidium stage only). ---------- Fayoum, Nov. 22, 1927. L.E.M. et al.
On Cucurbita sp. ---------- Beni Suef, Nov. 26, 1927. L.E.M. et al.
On Cucurbita sp. ---------- Beni Hassan, Nov. 22, 1927 L.E.M. et al
On Hibiscus esculentus Linn. ---------- Egypt, 1920-22. B. J.
On Hibiscus esculentus Linn. ---------- Egypt, 1923. T. F.

On Hibiscus esculentus Linn. ------	Egypt, Sept. 1928. R. M. N.
On leaf of Plantago lagopus Linn. -	Kafr Namran near Niltala by Pelusia, May, 1880.
Erysiphe communis (Wallr.) Fr. ?	
On Convolvulus (arvensis?) ------	Dakahlieh, Nov., 1927. L.E.M. et al.
Erysiphe graminis DC.	
On Hordeum vulgare Linn. -------	Giza farm, Mar. 28, 1928. L.E.M. et al.
On Lolium perenne Linn. ---------	Mit Kamo, Apr., 1822-25.
On Phalaris minor Retz. v. gracilis Parl. ----------------------	West Mariout Lake, Apr. 13, 1908.
On Polypogon monspeliensis Desf.-	San, Mar., 1822-25.
Erysiphe polygoni DC.	
On Foeniculum vulgare Mill. ------	Egypt, 1923. T. F.
On Pisum sativum Linn. --------	Manfalut, Jan. 9, 1928. L.E.M. et al.
On Trifolium alexandrinum Linn. - (oidium stage only) -----------	Manfalut, 1920-22. B. J.
On Trifolium alexandrinum Linn. -	Egypt. 1924-25.
Erysiphe taurica Lev.	
On Solanum melongena Linn. ----	Manfalut, 1923. T. F
Excascus deformans (Berk.) Fuck.	
On leaves Amygdalus persica Linn.	Egypt, 1920-22. B. J.
On leaves of Prunus persica Stokes	Manzaleh, 1887 (?).
Flammula acuminatospora I. Reichert	
Near canal. --------------------.	Ras-el-Khalig, Oct. 29, 1909.
Flammula schweinfurthii I. Reichert	Heliopolis and Assuit, date (?).
Fomes fomentarius (L.) Fr.	
On rhizome of Phragmites communis Trin. v. isiaca (Del.) Cosson --	Alexandria, 1910.
Fomes lucidus (Leys.) Fr.	
On stems of Citrus sp. -----------	?, 1889.
Fumago vagans Pers.	
On leaves of Dalbergia melanoxylon Guill. & Perr. --------------	Cairo (Shubra), date ?.
Fusarium roseum Link	
On Oryza sativa Linn. -----------	Rosetta, date ?.
Fusarium solani (Mart.) Sacc.	
On Citrus sp. causing twig gum disease. ------------------------	Egypt, 1924-25, S.-el-D.[1]
Fusarium uredinicola J. Mueller	
In sori of Puccinia cessati Schroet. occurring on Andropogon annulatus Forsk. -----------------------	Suez, date ?.

1. This organism isolated and proved to be pathogenic by Dr. Sirag-el-Din.

Fusarium spp.

On Citrullus vulgaris Schrad. (wilt) Lower and middle Egypt, 1924-25.
On Citrullus vulgaris Schrad. (wilt) Giza Prov., 1928. L.E.M. et al.
On Gossypium sp. wilt of cotton -- Egypt, 1920-22. B. J.
On Gossypium sp. wilt of cotton -- Egypt, 1923, T. F.
On Gossypium sp. wilt of cotton -- Parts of Middle and Lower Egypt, 1927. L. E. M. et al.
On Gossypium sp. (wilt of Sakel cotton) ------------------------ In numerous areas Delta, Oct., 1927. L. E. M. et al.
On Gossypium sp. wilt of cotton -- Middle and Lower Egypt, 1928, L. E. M. et al.
On Gossypium sp. wilt of cotton -- Middle and Lower Egypt, 1929. L. E. M. et al.
On Solanum tuberosum Linn. ----- Alexandria, Mar., 1928.L. E.M. et al
On Solanum tuberosum Linn. ----- Barrage, Feb., 1928. L.E.M. et al.
On Vicia lens Coss. & Germ. ------ Central Egypt, 1927. L. E. M. et al.
On Vicia lens Coss. & Germ. ------ Esna & Luxor, Central Egypt, 1928. L. E. M. et al.

Fusicladium cynanchi I. Reichert

On leaves of Cynanchum acutum Linn. ------------------------- Damietta, April, 1822-25.

Galera rubiginosa Pers.

In soil containing leaf mold ------ Egypt, Apr. 15, 1902.

Galera tenera Schaeff.

In lawn Hotel Shepard ---------- Cairo, Dec. 10, 1893.

Gloesporium salicis West.

On Salix spp. ---------------- Giza, June 20, 1928. L. E. M. et a

Gloeosporium schweinfurthianum Thuem.

On Erodium glucophyllum Ait. --- Cairo (Wadi Dugla), May, 1879.

Glonium guttulatum I. Reichert

On Atriplicis sp. --------------- Abukir, Sept., 1822-25.

Glonium salsolae I. Reichert

On Salsola longifolia Forsk. ------ Abukir, Oct., 1822-25.

Graphiola phoenicis (Moug.) Poit.[1]

On Erodium glaucophyllum Ait. -- Alexandria, 1922-25.
On leaves Phoenix dactylifera Linn. Alexandria, Feb. 20, 1855.
On leaves Phoenix dactylifera Linn. Damietta, Apr. 21, 1887.
On leaves Phoenix dactylifera Linn. Burg-el-Brallus, Apr. 3, 1887.
On leaves Phoenix dactylifera Linn. Alexandria (Ramleh), May 29, 1890.
On leaves Phoenix dactylifera Linn. Rosetta, May 10, 1902.
On leaves Phoenix dactylifera Linn. Cairo (El Marg), Apr. 27, 1908.
On leaves Phoenix dactylifera Linn. Between El-Mex and Mariout, Apr. 10, 1908.

1. It is of interest to note that this fungus is not to be found in the oases of Siwa, Dakhla, Farafrah, Baharia and Khatga, where many date palms occur.

On leaves Phoenix dactylifera Linn. Alexandria, 1912.
On leaves Phoenix dactylifera Linn. Esna, date ?.
On leaves Phoenix dactylifera Linn. Near Kingi-Mariout, date ?.
On leaves Phoenix dactylifera Linn. Near Abu Hamrah in the Oasis
On leaves Phoenix dactylifera Linn. Qua veh, date ?.
On leaves Phoenix dactylifera Linn. Bahtim near Cairo, date ?.
On Phoenix dactylifera Linn. ----- Egypt, 1920-22. B. J.
On Phoenix dactylifera Linn. ----- Egypt, 1923. T. F.
On Phoenix dactylifera Linn. ----- Egypt, 1924-25.
On Phoenix dactylifera Linn. ----- common in Lower and Middle Egypt, 1927. L. E. M. et al.
On Phoenix dactylifera Linn. ----- common in Lower and Middle Egypt, 1928. L. E. M. et al.
On Phoenix dactylifera Linn. ----- common in Lower and Middle Egypt, 1929. L. E. M. et al.

Guignardia aegyptiaca (Mueller Arg.) I. Reichert
On (limestone) calcium in desert-- Wadi Cherese, Wadi Naumieh, and Wadi Nehiel, 1880 (?).

Gyrophragmium delilei Mont.
In tomato fields ---------------- Alexandria (Ramleh), May 25, 1893.
Along sea coast ---------------- Wadi-el-Arish, 1901 (?).
In sand ---------------------- Giza pyramids, Apr. 25, 1908.
Near sea --------------------- Alexandria (Ramleh), May 7, 1912.

Helminthosporium gramineum Rabh.
On Hordeum vulgare Linn. ------ Egypt, 1920-22. B. J.
On Hordeum vulgare Linn. ------ Egypt, 1923. T. F.
On Hordeum vulgare Linn. ------ Damanhour, Jan. 31, 1928, L.E.M.et al.

Helminthosporium oryzae v. Breda de Haan
On Oryza sativa Linn. ---------- Dakahlieh Prov., Nov., 1927. L. E. M. et al.
On Oryza sativa Linn. ---------- Derin, Nabaroh, Talkha, Nov. 3, 1927. L. E. M. et al.
On Oryza sativa Linn. ---------- Damanhour, Nov. 6, 1927. L.E M.et al.
On Oryza sativa Linn. ---------- Sakha Domains, Oct. 27, 1927. L. E. M. et al.
On Oryza sativa Linn. ---------- Sidi Ghazi, Biela, Merabin, Kafr-el-Shiekh, Talkha, Nov. 4, 1927. L. E. M. et al.
On Oryza sativa Linn. ---------- Kafr-el-Shiekh, Jan. 17, 1929. L. E. M. et al.

Helminthosporium teres Sacc.
On Hordeum vulgare Linn. ------ Egypt, 1920-22. B. J.
On Hordeum vulgare Linn. ------ Egypt, 1923. T. F.
On Hordeum vulgare Linn. ------ Giza, Feb. 10, 1928. L. E. M. et al.

On Hordeum vulgare Linn. ------	Kaliubieh, Mar. 11, 1928. L.E.M. et al.
Helminthosporium turcicum Pass.	
On Zea mays Linn. --------------	Egypt, 1920-22. B.J.
On Zea mays Linn. --------------	Egypt, 1923. T. F.
Helminthosporium spp.	
On Oryza sativa Linn. -----------	Fayoum, Nov. 24, 1927. L.E.M. et al.
On Oryza sativa Linn. -----------	Gharbieh Prov., Nov., 1927. L. E. M. et al.
On Oryza sativa Linn. -----------	Kafr-el-Teraa, Nov. 1, 1927. L. E. M. et al.
On Oryza sativa Linn. -----------	Mansura, Oct. 30, 1927. L.E.M. et al.
Heterosporium sp.	
On Hordeum vulgare Linn. -------	Gebel-el-Asfar, Mar. 17, 1928. L. E. M. et al.
Hormiscium calligoni I. Reichert	
On Calligonum comosum L'Herit --	Bir Haie and Bir Lebek, Dec., 1822-25.
Hormiscium saccharicolum I. Reichert	
On Saccharum biflorum Forsk. ----	Girga and Akhmim, Jan., 1822-25.
Hydnum boveanum Mont.	
On decayed wood. ---------------	Cairo, 1835.
Hypholoma appendiculatum Bull.	
Garden soil --------------------	In the vicinity of Ismailia, Dec., 1886.
On soil ------------------------	Zagazig, Jan. 5, 1892.
Garden soil --------------------	Heluan, Jan. 28, 1900.
Garden soil --------------------	Gesire-Fleurist, Dec., 1901.
Habitat? ----------------------	West Cairo, Jan., 1912.
Habitat? ----------------------	Cairo & Fayoum, date ?.
Hypomyces galericola P. Henn.	
On Galera rubiginosa (Pers.) Sacc.	Cairo, Apr. 15, 1902.
Inoloma bolare (Pers.) Fr.	
In sands ----------------------	Alexandria (Ramleh), date ?.
Ithyphallus impudicus (L.) Fr.	
	Damietta and Assuit, date ?.
Kuehneola fici Butl.	
On leaves of Ficus carica Linn. ---	Alexandria (Ramleh), Dec., 1879.
Lentinus integrus I. Reichert	
On trunk of Ficus carica Linn.----	Alexandria; Dec., 1908.
Lentinus lepideus Fr.	
On sand dunes -----------------	near Dekhelah west of Alexandria, date ?.
Lentinus omphalopsis I. Reichert	
Habitat? ----------------------	Karnak, Mar., 1914.
Lepiota holosericea Fr.	
On Cynodon dactylon Pers. -------	Alexandria (Ramleh), Nov., 1910.
On Cynodon dactylon Pers. in garden	West Cairo, Dec., 1910.
On Cynodon dactylon Pers. in garden	W. bank of Nile, Cairo, Nov. 25, 1913.

Lepiota meleagris Sowerb.
In soil ---------- Luxor, Jan., 1902.

Leptosphaeria donacina Sacc.
On Phragmites communis Trin. v. isiaca (Del.) Cosson ---------- Egypt, date ?.

Macrophoma engleriana I. Reichert
On Anabasis articulata Moq. ------ Kahiram, 1822-25.

Macrosporium commune Rabenh.
On decayed melons ---------- Cairo, 1901 (?).

Macrosporium cucumerium Ell. & Ev.
On leaves of melon (Shamam), Cucumis sp. ---------- Rafah, May 25, 1928. L.E.M. et al.

Macrosporium euphorbiae I. Reichert
On leaves of Euphorbia prunifolia Jacq. ---------- near Salamum Mansura, Dec. 6, 1911.

Macrosporium oleae I. Reichert
On Olea europaea Linn. ---------- near Giza and Kahiram, Sept. 26, 1912.

Macrosporium solani Ell. & Mart.
(Erroneously reported as leaf curl)
On Solanum tuberosum Linn. ---- Egypt, 1923. T. F.

Macrosporium tomato Cke.
On Lycopersicum esculentum Mill.. Egypt, 1920-22.

Marssonina kriegeriana (Bres.) P. Magnus
On leaves Salix sp. ---------- Alexandria, date ?.
On leaves Salix tetrasperma Roxb. Delta region, 1930. R.M.N.

Melampsora euphorbiae (Schub.) Cast.
On Euphorbia cornuta Kers. ------ Dakahlia Prov., Nov. 4, 1927. L. E. M. et al.
On Euphorbia cornuta Kers. ------ El Arish, Mar. 21, 1928. L.E.M. et al.
On leaves and stems of Euphorbia peplus Linn. ---------- Damietta, Apr., 1822-25.
On leaves and stems of Euphorbia peplus Linn. ---------- Adueh in Fayoum, Mar., 1879.
On Euphorbia (several species) --- Kasr Dachl, Mar. 10, 1874.
On Euphorbia (several spp.) sandy fields ---------- Heliopolis, Mar. 12, 1880.

Melampsora euphorbiae-gerardianae W. Mueller
On leaves of Euphorbia cornuta Pers. ---------- El Arish and Foqirah, May 6, 1887.

Melampsora helioscopiae Winter
On Euphorbia arguta Soland. ------ Sal near Suakin, Mar., 1875.
On Euphorbia peploides Gouan. --- Bahtim (near Cairo), Apr. 13, 1912.

Melampsora lini (Schum.) Desm.
On Linum usitatissimum Linn. -- Damietta, Apr., 1876.

On Linum usitatissimum Linn. -- Fayoum, Jan., 1877.
On Linum usitatissimum Linn. -- Giza, Mar. 14, 1928. L. E. M. et al.

Melampsora ricini Pass.
On Ricinus communis Linn. ------ Suez, date ?.
On Ricinus communis Linn. ------ Egypt, 1920-22. B. J.
On Ricinus communis Linn. ------ Giza, Mar. 17, 1928. L. E. M. et al.

Melampsora (salicis-albae Kieb.)?
On Salix sp. --------------------- Giza, Mar. 10, 1928. S. el D.

Melanconium echinosporum I. Reich.
On Phragmites communis Trin. v. isiaca (Del.) Cosson ------------ Egypt, Mar. 1822-25.

Melanopsamma pomiformis (Pers.) Sacc.
On Phragmites communis Trin. --- Damietta, March, 1822-25.

Microdiplodia machlaiana I. Reichert
On Phragmites communis Trin. v. isiaca (Del.) Cosson ----------- Egypt, date ?.

Montagnites radiosus (Pallas) Holl.
Habitat? ------------------------ Wadi Riched Heluan, Feb. 19 & Mar. 11, 1900.
At mouth of Wadi Duglar -------- Cairo, Apr. 22, 1902.
On the sands -------------------- El Arish, date ?.

Morchella conica Pers.
In soil in park at Giza ------------ Cairo, Dec. 12, 1901.

Morchella esculenta (L.) Pers. f. rotunda Fr.
In garden ------------------------ Cairo (?), Nov. 30, 1886.

Mycosphaerella engleriana I. Reichert
On Noaea mucronata Aschers. & Schweinf. --------------------- Abukir, Oct., 1822-25.
On Salsola longifolia Forsk. ------ Abukir, Oct., 1822-25.

Mycosphaerella fragariae (Schwein.) Lind.
On Fragaria sp. ------------------ Egypt, 1920-22. B. J.

Naucoria pediades Fr.
In garden hotel ------------------ Heluan, Jan., 1900.
On canal bank ------------------- Sidi Gaber, June, 1901.

Naucoria vervacti Fr.
In Egyptian-Arabian desert ------ Egypt, date ?.

Neocosmospora vasinfecta (Atk.) EFS.
On Arachis hypogaea Linn. ------- Sharkia, Aug. 13, 1928. R. M. N.
On Gossypium sp. ---------------- Various places in Egypt, date ?.

Oidiopsis taurica (Lev.) Salm.
On Capsicum sp. ----------------- Alexandria, Giza, Feb. 1927. L. E. M. et al.

On Capsicum sp. ---------------- Beni Suef, Nov. 26, 1927. L.E.M. et al.
On Capsicum sp. ---------------- Mansura, Oct. 31, 1927. L.E.M. et al.
On Glycyrrhiza glabra Linn. ----- Baharia Oasis, Oct., 1928. R.M.N.
On Hibiscus cannabinus Linn. ----- Egypt, 1920-22. B. J.
On Hibiscus cannabinus Linn. --- - Giza, Sept., 1929. R.M.N.
On Solanum melongena Linn. ----- Egypt, 1920-22. B. J.
On Solanum melongena Linn. ----- Egypt, 1923. T. F.
On Solanum melongena Linn. ----- Tanta, Nov. 12, 1927. L.E.M. et al.
On Solanum melongena Linn. ----- Alexandria, Nov. 12, 1927. L.E.M.et al.
On Solanum melongena Linn. ----- Mansura, Nov. 4, 1927. L.E.M. et al.

Oidiopsis sp.
On Alhagi maurorum Medic. ----- Kharga oasis, Jan. 9, 1929. L.E.M. and M. B.
On Malva sp. ------------------- Minia, Nov. 23, 1927. L.E.M.& M.B.

Oidium abelmoschi Thuem.
On leaves Hibiscus esculentus Linn. Mansura, July, 1876.
On leaves Hibiscus esculentus Linn. Libyan desert (El Homrah, date ?.)
On leaves Hibiscus esculentus Linn. near Shubra, date ?.

Oidium erysiphoides Fr.
On leaves of Ammi majus Linn. -- Assuit, Mar., 1893.
On leaves Melilotus parviflorus Desf. Ishmailla, Apr., 1880.
On leaves Melilotus parviflorus Desf. Rosetta, May 10, 1902.
On leaves of Trifolium alexandrinum Linn. -------------------------- Minich, Apr., 1893.
On leaves of Trigonella foenum-graecum Linn. ---------------- Fayoum, Mar., 1879.
On leaves Trigonella hamosa Linn. Assuit, Mar., 1893.
On leaves Trigonella laciniata Linn. Assuit, Mar., 1893.
On leaves Trigonella stellata Forsk. In desert of Wadi Aschar, Mar., 1877.
On leaves of Vicia calcarata Desf. - Fayoum, Apr., 1879.

Oidium leucoconium Desm.
On Rosa centifolia Linn. --------- Cairo, Dec., 1875.
On Rosa sp. -------------------- Kafr Demuhra near Zagazig, Dec. 8, 1901.

Oidium lippiae Thuem.
On leaves of Lippia nodiflora Cham. Gesirah near Cairo, date ?.

Oidium mangiferae Berthet.
On Mangifera indica Linn. -------- Egypt, 1920-22. B. J.

Oidium medicagineum Thuem.
On Medicago denticulata Willd. --- Fayoum, Mar., 1879.

Oidium sp.
On Hibiscus esculentus Linn. ----- Mit Ghamr, Oct. 21, 1928. L.E.M.et al.
On Mangifera indica Linn. blossom Egypt, 1930. H. S. Fawcett.

Panaeolus campanulatus L.
Manured garden soil ------------ Giza, Oct. 11, 1901.

On horse manure in garden, Hotel Grand .... Luxor, Mar. 17, 1902.

Panaeolus fimicola Fr.

Garden Hotel Shepard .... Cairo, Dec., 1893.

Panaeolus retirugis Fr.

Garden soil under Citrus tree .... Giza, Apr. 24, 1893.

Grass plot edge of canal bank .... Ras-el-Khalig, Oct. 25, 1909

In garden .... Luxor, Feb., 1914.

Penicillium digitatum (Fr.) Sacc.

On Citrus sp. .... Egypt, 1920-22. B. J.

On Citrus sp. .... Egypt, 1930. H. S. Fawcett

Penicillium italicum Wehmer

On Citris sp. .... Egypt, 1920-22. B. J.

On Citris sp. .... Egypt, 1930. H. S. Fawcett.

Peronospora alsinearum Casp.

On Alsine sp. .... Fayoum, Dec., 1879.

Peronospora arborescens (Berk.) DeBary

On Papaver somniferum Linn. .... Egypt, 1920-22. B. J.

Peronospora effusa (Grev.) Rabh.

On Spinacia oleracea Linn. .... Egypt, 1920-22. B. J.

On Spinacia oleracea Linn. .... Cairo, Feb., 1927. L. E. M. & M. B.

Peronospora parasitica (Pers.) DeBary

On Brassica oleracea Linn. .... Egypt, 1920-22. B. J.

On Brassica oleracea Linn. .... Egypt, 1923. T. F.

Peronospora schleideni Ung.

On Allium cepa Linn. .... Egypt, 1923. T. F.

On Allium cepa Linn. .... Khorkania, Apr. 19, 1928. M. B

Peronospora sparsa Berk.

On Rosa spp. .... Egypt, 1924-25.

Peronospora trifoliorum DeBary

On Melilotus sp. .... Egypt, 1920-22. B. J.

Peronospora viciae (Berk.) DeBary

On Vicia faba Linn. .... Egypt, 1923. T. F.

Pharcidia epicymatia (Wallr.) Winter

On Lecanora cerina (Ehrh.) Ach. .. Ras-el-Kanais, 1901(?).

Phellorina delestrei E. Fischer

Habitat ? .... Wadi Arab, date ?.

Phellorina squamosa Kalchbr. & Mac.

Habitat ? .... El Arish near Sat, May 6, 1887.

Habitat ? .... Giza pyramids, date ?.

Habitat ? .... Wadi Alor, date ?.

Habitat ? .... Wadi Arab, date ?.

Phellorina squamosa Kalchbr. & Mac. Ow. v. mongolica P. Henn.

Habitat ? ---------------------- Wadi Arab, Apr. 22, 1877.

Pholiota alexandrina I. Reichert
Alexandria, Dec. 1, 1909.

Phomopsis citri Fawc.
On Citrus sp. ------------------ Egypt, 1920-22. B. J.
On Citrus sp. ------------------ Egypt, 1923. T. F.

Phomopsis sp.
On Phoenix dactylifera Linn. ---- Egypt, 1930. H. S. Fawcett.

Phragmidium disciflorum (Tode) James
On Rosa centifolia Linn. --------- Cairo, Dec., 1875.

Phragmidium subcorticium (Schrank) Wint.
On Rosa spp. -------------------- Egypt, 1920-22. B. J.
On Rosa spp. -------------------- Egypt, 1923. T. F.
On Rosa spp. -------------------- Mansura, Nov. 4, 1927. L.E.M. et al.

Phragmidium violaceum (Schultz) Wint.
On Rubus sp.[1] ------------------ Mehalet-el-Kasab, Dec. 4, 1927. L. E. M. et al.

Phyllachora cynodontis (Sacc.) Niessl.
On Cynodon dactylon Pers. ------- Cairo, Apr., 1872.
On Cynodon dactylon Pers. ------- Cairo, Apr., 27, 1908.
On Cynodon dactylon Pers. ------- Alexandria, Apr. 7, 1908.
On sandy soil ------------------ Alexandria, Jan. 22, 1880.
Tscheile Lachterie, Sept., 1822-25.
Foa, Jan., 1822-25.
Sanna, Mar., 1822-25.

Phyllachora ehrenbergii I. Reichert
On Cyperus auricomus Sieber ---- Machsamah, Apr. 25, 1887.
On Cyperus radiatus Vahl. ------- Damietta, Apr., 1822-25.

Phyllachora (graminis ?) (Pers.) Fuck.
On undetermined grass ---------- Amria, Oct. 15, 1928. L.E.M. et al.
On undetermined grass ---------- Meadi, Jan. 2, 1929. R. N.

Phyllachora trifolii (Pers.) Fuck. ---
On Trifolium resupinatum Linn. -- El Marg, Cairo, Apr. 27, 1918.

Phyllosticta gossypina Ell. & Mart.
On Gossypium sp. --------------- Gemaiza, Oct. 16, 1927. L. E. M.

Phyllosticta palmarum Rabenh.
On Phoenix dactylifera Linn. ------ Esna, date ?.

Phytophthora citrophthora (See Pythiacystis)

Phytophthora infestans (Mont.) De Bary
On Solanum lycopersicum Linn. --- Fayoum, Jan., 1877.

1. First time reported on host. Det. by W. W. Diehl and R. W. Davidson.

Pilosace algeriensis Fr.	
Garden	Island Rhodah, Cairo, Feb., 1887.
Habitat ?	Cairo, 1901 (?).
Plasmopara cubensis (B.& C.) Humph.[1]	
On Citrullus vulgaris Schrad.	Egypt, 1923. T. F.
On Citrullus vulgaris Schrad.	Egypt, 1924-1925. T. F.
Plasmopara viticola (B. & C.) Berl & De Toni	
On Vitis vinifera Linn.	Egypt, 1920-22. B. J.
On Vitis vinifera Linn.	Egypt, 1923. T. F.
On Vitis sp. (grape)	Barrage, Aug. 10, 1927. L.E.M. et al.
On Vitis sp. (grape)	Zifta, July 9, 1928. L.E.M. et al.
Pleospora aegyptiaca I. Reichert	
On Alsine procumbens Fenzl.	Alexandria, Sept., 1821-25.
Pleospora asphodeli Rabenh.	
On stems of Asphodelus microcarpus Viviani	Egypt, Sept. & Oct., 1822-25.
Pleospora herbarum (Pers.) Rabenh.	
On Linum usitatissimum Linn.	Island of Cyprus, June, 1926.
Pleospora lindaviana I. Reichert	
On Salsola sp.	Kasr Eschtrach, Nov., 1822-25.
Pleospora rotundata I. Reichert	
On Lycium sp.	Bir Kres, Sept., 1822-25.
On Varthemia candicans Boiss.	Alexandria, 1822-25.
Pleurotus ficicola Mont.	
On trunk of Ficus sycomorus Linn.	Egypt, date ?.
Podaxon aegyptiacus Mont.	
In desert between Suez and Giza	Egypt, 1835.
On road to Gebel-el-Haschab	Egypt, May 5, 1879.
Podaxon arabicus Pat.	
In sand near	El Arish, 1901 (?).
Podaxon calyptratus Fr.	
	near Suakin, Sept. 18, 1868.
	West of Quatyeh, Apr. 29, 1887.
Border Libyan desert	near Abu Rawash, Cairo, Apr., 1890.
Podaxon carcinomalis (L.) Fr.	
In sand south of Great Pyramid	Giza, Apr. 16, 1884.
Podaxon deflersii Pat.	
In Egyptian desert	Egypt, 1822-25.
Podaxon indicus Spreng.	
Habitat ?	Near Bir Abu Belah, Apr. 27, 1880.
Podaxon squamosus Pat.	
Sands near	El Arish, 1901 (?).

1. This should be Pseudoperonospora cubensis (B. & C.) Rost.

Podosphaera oxyacanthae (Fr.) De-Bary ----------------------
On Prunus sp. ---------------- Egypt, 1920-22. B. J.

Polyporus hispidus (Bull.) Fr.
On stump of tree -------------- Cairo, Dec., 1908 (?).
On Populus spp. --------------- Egypt, 1920-22. B. J.
On Tamarix articulata Vahl. ------ Alexandria, Dec., 1908.

Polythrincium trifolii Kunze
On Trifolium resupinatum Linn. -- Mansura, Apr., 1822-25

Poria terrestris (DC.) Fr.
Habitat ? --------------------- Egypt, date ?.

Psalliota campestris (L.) Fr. = Agaricus campestris Linn.
In garden French consulate ------ Suez, 1901 (?).
Habitat ? --------------------- Cairo, date ?.
Habitat ? --------------------- Rosetta, date ?.

Psalliota campestris (L.) Fr. f. alba Vitt.
Edge of well ------------------ Cairo, Nov., 1886.

Psathyra schweinfurthii (Roumeg.) I. Reichert
At base of orange tree ---------- Cairo, Dec., 1886.
Cairo and Kassr-el-Ain, date ?.

Pseudomonas tritici Hutchinson
On Triticum sp. ---------------- Egypt, 1920-22. B. J.
On Triticum sp. ---------------- Gemmaiza, Mar. 15, 1928.[1] L.E.M.et al.

Pseudoperonospora cubensis (B. & C.) Rost. (See Plasmopara)

Pseudopeziza (Phacidium) trifolii (Bernh.) Fckl. v. medicaginis Lib.
On Medicago sativa ------------- Giza, Apr., 1899. Fletcher.

Pterophyllus bovei Lev.=**Pleurotus ficicola** Mont.
On trunk of Ficus sycomorus Linn. Egypt, 1844.

Puccinia absinthii DC.
On Artemisia herba-alba Asso --- In desert of Piorali, Egypt ?.

Puccinia allii (DC.) Rudolphi
On Allium sativum Linn. -------- Alexandria, July 27, 1928. L.E.M.et al.

Puccinia anomala Rostr.
On Hordeum vulgare Linn. ------ Giza, Mar. 27, 1928. L. E. M. et al.

Puccinia aristidae Tracy
On Aristida scoparia Trin. & Rupr. Station Quatyeh, Apr. 25, 1902.

Puccinia aristidicola P. Henn.
On Aristida acutiflora Trin. & Rupr. Reia Behera, Apr. 15, 1898.
On Aristida scoparia Trin. & Rupr. West of Behera, Apr. 15, 1898.

1. The author merely reports the occurrence and collection and has not determined the organism. Literature from Egypt states Pseudomonas tritici as the organism. It is associated with Tylenchus tritici infected ears.

Puccinia asphodeli Moug.
On leaves of Asphodelus sp. ------ Alexandria, date ?.

Puccinia barbeyi (Roum.) P. Magn.
On Asphodelus viscidulus Boiss. -- Rafa, May 25, 1928. L. E. M. et al.

Puccinia bromina Erikss.
On Bromus villosus Forsk. -------- Sidi-Gaber near Alexandria, Apr. 7, 1908.

Puccinia calcitrapae DC.
On Centaurea calcitrapa Linn. ---- Mansura, Mar., 1822-25.
On Centaurea calcitrapa Linn. ---- Alexandria, Jan., 1822-25.
On Centaurea calcitrapa Linn. ---- Mit Kamo, Apr., 1822-25.
On Centaurea calcitrapa Linn. ---- Benha, June 20, 1885.

Puccinia caricis (Schum.) Rebent.
On Carex divisa Huds. ----------- El-Marg, Cairo, Apr. 27, 1908.

Puccinia carthami (Hutzelm.) Cda.
On leaves of Carthamus tinctorius Linn. ------------------------ Cairo, date ?.
On leaves of Carthamus tinctorius Linn. ------------------------ Giza, June 12, 1887.

Puccinia centaureae DC.
On Centaurea sp. ---------------- near Alexandria, date ?.

Puccinia cesatii Schroet.
On Andropogon annulatus Forsk. - Cairo, Apr., 1822-25.
On Andropogon annulatus Forsk. - Giza, May 4, 1908.
On Andropogon annulatus Forsk. - Heliopolis, Apr. 25, 1908.

Puccinia coronifera Kelbahn= **P. coronata** Cda.
On Lolium perenne Linn. -------- Alexandria, Mar., 1822-25.
On Lolium perenne Linn. -------- Mit Kamo, Apr., 1822-25.
On Polypogon monspeliensis Desf.-- Alexandria near Gabbari, Apr. 26, 1874
On Polypogon monspeliensis Desf.-- Damietta, Apr. 18, 1912.

Puccinia cressae (DC.) Lagh.
On leaves of Cressa cretica Linn. -- Alexandria, Mar., 1822-25.
On leaves of Cressa cretica Linn. -- in rice fields near Alexandria, May 13, 1874.
On leaves of Cressa cretica Linn. -- near Damietta, July, 1876.
On leaves of Cressa cretica Linn. -- near Abukir, Mar. 23, 1877
On leaves of Cressa cretica Linn. -- near Fayoum, May 1884.
On leaves of Cressa cretica Linn. -- Heluan, date ?.
On leaves of Cressa cretica Linn. -- in desert near Suez, date ?.
On leaves of Cressa cretica Linn. -- near Sidi Galem near Parbieh, date ?.
On leaves of Cressa cretica Linn. -- near Baltin, Apr. 5, 1887.
On leaves of Cressa cretica Linn. -- Wadi Weheya, Nov. 1, 1928. L. E. M.

Puccinia cynosuroides (P. Henn.) Sydow

On leaves of Eragrostis bipinnata Muschler	Port Said, Nov. 19, 1901.

Puccinia dispersa Erikss. & Henn.

On Lolium temulentum Linn.	in rice field Alexandria, May 14, 18 4.

Puccinia eryngii DC.

On leaves of Eryngium campestre Linn.	Bir Kres, Mar., 1822-25.
On Eryngium sp.	near Mex, 1901 (?).

Puccinia frankeniae Link

On leaves of Frankenia pulverulenta Linn.	Sserssena near Faycum, Mar., 1879.
On leaves of Frankenia pulverulenta Linn.	East of Damietta, Apr. 17, 1902.

Puccinia glumarum (Schum.) Erikss. & Henn.

On Hordeum vulgare Linn.	Mansura, date ?.
On Hordeum vulgare Linn.	Egypt, 1920-22. B. J.
On Hordeum vulgare Linn.	Egypt, 1923. T. F.
On Hordeum vulgare Linn.	Giza crop, 1927. L. E. M. et al.
On Triticum sp.	Egypt, 1920-22. B. J.
On Triticum sp.	Egypt, 1923. T. F.
On Triticum sp.	Giza, Mar. 24, 1928. L. E.M. et al.
On Triticum sp.	Distamia, May 4, 1928. L. E. M. et al.
On Triticum sp.	Barrage, Apr. 21, 1928. L. E. M. et al.
On Triticum sp.	Nag Hamadi, Feb. 26, 1928. L. E. M. et al.
On Triticum sp.	Zahweir, Shebin, Mar. 17, 1928. L. E. M. et al.

Puccinia graminis Pers.

On Avena sativa Linn.	Egypt, 1920-22. B. J.
On Avena sativa Linn.	Gebal-el-Qslar, Apr. 2, 1928. L. E. M. et al.
On Hordeum vulgare Linn.	Beni Suef. date ?.
On Hordeum vulgare Linn.	Egypt, 1920-22. B. J.
On Triticum sp.	Egypt, 1920-22. B. J.
On Triticum sp.	Egypt, 1923. T. F.
On Triticum sp.	Giza, March 19, 1928. L. E. M. et al.

Puccinia helianthi Schw.

On Helianthus annuus Linn.	Egypt, 1924-25.
On Helianthus annuus Linn.	Giza, May 10, 1927. L. E. M. et al.
On Helianthus annuus Linn.	Giza, July 17, 1928. L. E. M. et al.

Puccinia isiacae (Thuem.) Winter

On leaves of Phragmites communis Trin. v. isiaca (Del.) Cosson	Damietta, Mar., 1822-25.
In a sulphur pond	Heluan, June, 1877.

Puccinia launaeae R. Maire
On Launaea glomerata Hook. ----- Mahadi near Cairo, date ?.
On Launaea glomerata Hook. ----- Tura near Cairo, date ?.
On leaves of Launaea nudicaulis Hook. ------------------------ El Marg near Cairo, Apr. 27, 1908.

Puccinia longissima Schroet.
On Koeleria berythea Boiss. & Blanche ---------------------- Egypt, date ?.

Puccinia magnusiana Koern.
On Phragmites communis Trin. v. isiaca (Del.) Cosson ---------- Damietta, date ?.

Puccinia maydis Bereng.
On Zea mays Linn. -------------- Egypt, 1920-22. B. J.
On Zea mays Linn. -------------- Egypt, 1923. T. F.
On Zea mays Linn. -------------- Giza, Oct. 8, 1928. L. E. M. et al.

Puccinia menthae Pers.
On Mentha sp. ------------------ Desouk, June 5, 1929. S -el -N.

Puccinia paraphysata I. Reichert
On leaves of Festuca dertonensis Aschers. & Graebn. ----------- Egypt, May 9, 1910.

Puccinia pruni-spinosae Pers.
On Amygdalus communis Linn. --- Egypt, 1920-22. B. J.
On Amygdalus communis Linn. --- Egypt, 1923. T. F.
On leaves of Prunus armeniaca Linn. Cairo, Nov., 1913.
On leaves of Prunus persica Stokes Cairo, Feb. 10, 1180 (?)[1]

Puccinia pulvinata Rbh.
On leaves of Echinops spinosus Linn. ------------------------ Alexandria, Mar., 1822-25.
Sand dunes -------------------- near Alexandria, date ?.

Puccinia purpurea Cke.
On Andropogon halepensis Brot. -- Damietta, Mar., 1822-25.

Puccinia rimosa (Link) Wint.
On Juncus acutus Linn. ---------- Damietta, Apr., 1822-25.
On Juncus maritimus Lam. ------- between Gaza and El Arish, May 12, 1877.
On Juncus subulatus Forsk. ------ El Arish, May 24, 1928. L. E. M. et al.
On Juncus sp. ------------------ Alexandria, Oct., 1822-25.
On Juncus sp. ------------------ Ramleh, Alexandria, May 29, 1890.
On Juncus sp. ------------------ Ramleh, Alexandria, Apr. 1, 1892.

Puccinia rottboelliae Sydow
On Rottboellia compressa Linn. -- Nile Delta, Dec., 1911.

Puccinia rufipes Diet.
On Imperata cylindrica Beauv. ---- Damietta, Apr., 1820-25.
On Imperata cylindrica Beauv. ---- El-Marg near Cairo, Apr. 27, 1908.
On Imperata cylindrica Beauv. ---- Shubra near Cairo, date ?.

1. I. Reichert in Die Pilzflora Aegyptens records this year. It unquestionably is an error.

Puccinia santolinae P. Magnus
On Achillea santolina Linn. ------ Near Amria, Apr. 13, 1903.

Puccinia scirpi DC.
On Scirpus sp. in swamps -------- Mallaha, date ?.
On Scirpus sp. in swamps -------- Damietta, Mar., 1822-25.

Puccinia simplex (Koern.) Erikss. & Henn.
On Hordeum vulgare Linn. ------- Mansura, 1822-25.
On Hordeum vulgare Linn. ------- Damietta, Apr., 1822-25.

Puccinia sorghi Schw.
On Zea mays Linn. --------------- Giza, Oct. 8, 1928. L. E. M. et al.

Puccinia triticina Erikss.
On Triticum durum Desf. -------- Giza, Apr. 21, 1908.
On Triticum vulgare Vill. -------- Beni Suef, date ?.
On Triticum vulgare f. coerulescens Assuit, 1893.
On Triticum sp. ----------------- Egypt, 1920-22. B. J.
On Triticum sp. ----------------- Egypt, 1923. T. F.
On Triticum sp. ----------------- Giza, Jan. 19, 1928. L. E. M.[1]
On Triticum sp. ----------------- Abu Amowri, Feb. 22, 1928. L. E. M. et al.
On Triticum sp. ----------------- Benha, Mar. 7, 1928. L.E.M. et al.
On Triticum sp. ----------------- Sahali, Mar. 14, 1928. L.E.M. et al.
On Triticum sp. ----------------- M't Bera, Mar. 28, 1928. L.E.M. et al.
On Triticum sp. ----------------- Diguoi, Mar. 30, 1928. L. E. M. et al.
On Triticum sp. ----------------- Tahabush, Apr. 10, 1928. L.E M. et al.
On Triticum sp. ----------------- Mushtohor, Apr. 11, 1928. L.E.M. et al.
On Triticum sp. ----------------- Kaliub. Apr. 14, 1928. L. E. M. et al.
On Triticum sp. ----------------- Kafr-el-Shiekh, Apr. 14, 1928. L. E. M. et al.

Puccinia turgida Sydow
On Lycium europaeum Linn. ------ El Arish, Sinai Penn., May 23, 1928. L. E. M. et al.

Puccinia verruca Thuem.
On Centaurea napifolia Linn. ----- Upper Egypt, date ?.

Pythiacystis citrophthora Sm. & Sm.
On Citrus sp. ------------------- Egypt, 1920-22. B. J.
On Citrus sp. ------------------- Egypt, 1923. T. F.
On Citrus sp. ------------------- Egypt. 1927. M. B. & S-el-D.
On Citrus sp. ------------------- Egypt, 1928. M. B.
On Citrus sp. ------------------- Egypt, 1930. S-el-D.[2]
On Citrus sp. orange, lemon bark -- Egypt, 1930. H. S. Fawcett.

Pythium de baryanum Hesse
On Gossypium sp. --------------- Giza, 1905. W. Balls.

1. Earliest monthly record of its occurence on Triticum sp.
2. The first time it has been definitely cultured and determined in Egypt.

Ramularia sp.
On Capsicum sp. ---------------- Mansura, Oct. 15, 1927.[1] L.E.M. et al.
Rhizoctonia spp.
On Arachis hypogaea Linn. ------ Egypt, 1920-22. B. J.
On Brassica oleracea Linn. ------ Egypt, 1920-22. B. J.
On Citrullus vulgaris Schrad. ----- Egypt, 1920-22. B. J.
On Cucurbita sp. (pumpkin) ------ Egypt, 1920-22. B. J.
On Daucus carota Linn. ---------- Egypt, 1920-22. B. J.
On Gossypium seedlings ---------- Egypt, 1920-22. B. J.
On Gossypium seedlings --------- Egypt, 1927. L. E. M. et al.
On Gossypium seedlings --------- Egypt, 1928. L. E. M. et al.
On Gossypium seedlings --------- Egypt, 1929. L. E. M. et al.
On Lactuca sativa Linn. --------- Egypt, 1920-22. B. J.
On Medicago sativa Linn. -------- Egypt, 1920-22. B. J.
On Pisum sativum Linn. --------- Egypt, 1920-22. B. J.
On Raphanus sativus Linn. ------- Egypt, 1920-22. B. J.
On Ricinus communis Linn. ------ Egypt, 1920-22. B. J.
On Sesamum sp. ---------------- Egypt, 1920-22. B. J.
On Triticum sp. (root rot) ------- Dakahlieh Prov., Dec., 1927. L. E. M. et al.
Rhizopus nigricans Ehr.
On Gossypium bolls ------------- Egypt, 1920-22. B. J.
On Gossypium bolls ------------- Egypt, 1923. T. F.
Schizophyllum commune Fr.
On wooden cask --------------- Alexandria, date ?.
Scirrhia rimosa (Alb. & Schw.) Fuck.
On Phragmites communis Trin. var. isiaca (Del.) Cosson ------- Menzaleh, Mar., 1822-25.
Sclerospora graminicola (Sacc.) Schroet. var. andropogonis-sorghi Kulkarni
On Holcus sorghum Linn. -------- Giza, July 1, 1928. L. E. M. et al.
On Zea mays Linn.[2] ------------- Giza, July 13, 1928. S -el-D.
Sclerotium rolfsii Sacc.
On Cynara scolymus Linn. ------- Egypt, 1920-22. B. J.
On Cynara scolymus Linn. ------- Egypt, 1923. T. F.
On Cynara scolymus Linn. ------- Barrage, Nov., 1927. L. E. M. et al.
Sorosporium desertorum Thuem.
On Elionurus hirsutus Munro ----- Wadi Gudeli, April, 1879.
On Elionurus hirsutus Munro ----- North Arabian Desert, Wadi Chafura, Apr. 9, 1880.
Sorosporium ehrenbergii J. Kuhn
On Andropogon sorghum Brot. ---- Cairo & Damietta, July, 1876.
Sorosporium reilianum (Kuehn) McAlp.

1. Seems to be a new species of Ramularia. L.E.M.
2. First time reported to science on this host.

On Holcus sorghum Linn. -------- Fayoum, Nov. 25, 1928. L. E. M. et al.
On Holcus sorghum Linn. -------- Kena, Assuit, July 5, 1928. L. E. M. et al.

Sphacelotheca ischaemi (Fuck.) Clinton
On Andropogon foveolatus Delile-- Cairo, May, 1820.
On Pennisetum dichotomum Delile- Suez, May 20, 1908.

Sphacelotheca penniseti (Rbh.) I. Reichert
On Pennisetum dichotomum Delile- Wadi Hof near Heluan, date ?.
On Pennisetum dichotomum Delile- near Basettin near Cairo, Apr. 11, 1878.
On Pennisetum dichotomum Delile- Wadi Chafura, Apr. 30, 1880.
On Pennisetum dichotomum Delile- Heluan, May 3, 1883 (?).

Sphacelotheca reiliana (Kuehn) Clint. =**Sorosporium reilianum** (Kuehn) McAlp.
On Andropogon sorghum Brot. ---- Sakkarah, June 17, 1868.
On Andropogon sorghum Brot. ---- Cairo, 1869. Reil.
On Andropogon sorghum Brot. ---- Assuan, Jan. 6, 1907.
On Andropogon sorghum Brot. ---- Assuit, Dec. 25, 1908.

Sphacelotheca schweinfurthiana (Thuem.) Sacc.
On Imperata cylindrica Beauv. --- Cairo, 1864.
On Imperata cylindrica Beauv. --- Alexandria, 1876 (?).
On Imperata cylindrica Beauv. --- Damietta, 1876 (?).
On Imperata cylindrica Beauv. --- Kharga Oases, date ?.
On Imperata cylindrica Beauv. --- Small Oasis, Libyan desert, El-Hais, date ?.
On Imperata cylindrica Beauv. --- Mansura, 1876 (?).
On Imperata cylindrica Beauv. --- Farafrah Oasis, 1876.
On Imperata cylindrica Beauv. --- Oases in Daklah, 1876.
On Imperata cylindrica Beauv. --- Wadi Tumilat, May, 1880.
On Imperata cylindrica Beauv. --- Shubra, Cairo, Oct., 1887.
On Imperata cylindrica Beauv. --- Assuit, Mar. 27, 1893.
On Imperata cylindrica Beauv. --- Giza, May 4, 1908.
On Imperata cylindrica Beauv. --- Egypt, 1920-22. B. J.
On Imperata cylindrica Beauv. --- Giza, Oct. 2, 1928. L. E. M. et al.

Sphacelotheca sorghi (Link) Clint.
On Andropogon sorghum Brot. ---- Cairo, date ?.
On Andropogon sorghum Brot. ---- Egypt, 1920-22. B. J.
On Andropogon sorghum Brot. ---- Egypt, 1923. T. F.
On Holcus sorghum Linn. -------- Fayoum, 1927. L. E. M. et al.
On Holcus sorghum Linn. -------- Kena, Assuit, 1928. L. E. M. et al.

Sphaeria hypoxantha Lev.
Habitat ? -------------------- Cairo, 1871.

Sphaerodothis schweinfurthii I. Reichert	
On Sporobolus spicatus Kunth	Rosetta, 1822-25.
In desert near	Ismailia, Apr. 28, 1880.
Sphaeropsis visci (Westd.) Archer	
On mistletoe from England	Alexandria Customs Office, Jun. 17, 1929. R. M. N.
Sphaerotheca pannosa (Walr.) Lev.	
On Amygdalus persica Linn.	Lower Egypt, 1924-25.
On Amygdalus persica Linn.	Fayoum, May 12, 1928. M. B.
On Amygdalus persica Linn.	Beni Suef, May 15, 1928. M. B.
On Prunus armeniaca Linn.	Egypt, 1923. T. F.
On Rosa sp.	Egypt, 1920-22. B. J.
Oidium stage only	Egypt, Dec., 1927. L. E. M. et al.
Sporodesmium longipedicellatum I. Reichert	
On Gossypium sp.	Bahtim, Aug. 15, 1912.
Stereum hirsutum (Willd.) Fr.	
On Quercus sp. (dead)	Cairo, Dec. 23, 1902.
Stilbella dielsiana I. Reichert	
Habitat ?	Kahiram and Mansura, Mar., 1822-25.
Terfezia deflersii Pat.	
Desert waste	El Arish, date ?.
Terfezia leonis Tul.	
Sands, region of	Cairo, date ?.
Sands, region of	Bir-el-Abd near El Arish, date ?.
Tilletia levis Kuehn	
On Triticum sp.	Egypt, 1920-22. B. J.
Tilletia tritici (Bjerk.) Winter	
On Triticum durum Desf.	Zagazig, May 14, 1886.
Habitat ?	Egypt, 1923. T. F.
Tirmania africana Chat.	
Habitat ?	Mariout, Apr., 1887.
Tirmania ovalispora Pat.	
Libyan desert	Near Cairo, date ?.
Habitat ?	Mariout, Alexandria, Apr. 17, 1887.
Tolyposporium filiferum Busse	
On Andropogon sorghum Brot.	Egypt, 1920-22. B. J.
On Andropogon sorghum Brot.	Egypt, 1923. T. F.
On Andropogon sorghum Brot.	Fayoum, Nov. 24, 1927. L.E.M. et al
On Andropogon sorghum Brot.	Kena, Assuit, 1928. L. E. M. et al.
Torula herbarium Link	
On Pancratium sp.	Cairo, 1901 ?.
On Phragmites communis Trin. v. isiaca (Del.) Cosson	Mansura, 1822-25.

Torula opuntiae I. Reichert
On Opuntia ficus-indica Mill. ----- Kahiram, 1822-25.

Trametes odorata (Wulf) Fr.
On wood of water-wheels -------- Rosetta, date ?.

Tranzschelia punctata (Pers.) Arth.= **Puccinia pruni-spinosae** Pers.
On Amygdalus communis Linn. --- Rafah, May 25, 1928. L. E. M. et al.
On Amygdalus persica Linn. ------ Tanta, Nov. 13, 1927. L. E. M. et al.
On Amygdalus persica Linn. ------ Giza, Oct. 18, 1928. L.E.M. et al.
On Amygdalus persica Linn. ------ Kerashia, Oct. 30, 1928. L.E.M. et al.
On Prunus armenica Linn. ------- Korashia Province, Oct. 30, 1928. L. E. M. et al.
On Prunus sp. (Plum) ----------- Ragdia, Nov. 13, 1927. L.E.M. et al.
On Prunus sp. (Plum) ----------- Burg-el-Arab, Oct. 18, 1928. L. E. M. et al.

Trichloma melaleucum Pers.
Grass plots, Gardens Hotel Shepard Cairo, Dec. 10, 1893.

Tryblidium punctum Pat.
On twigs of Tamarix sp. --------- El Arish ?.

Tylostoma mammosum (Mich.) Fr.= **Lycoperdon mammosum** Mich.
In desert near ---------------- Cairo, date ?.

Tylostoma tortuosum Ehrenb.
In sand ----------------------- between Cairo and Suez, Apr. 22, 1879.
In sands of Egyptian-Syrian desert near El Arish, Mar. 25, 1880.
In desert ---------------------- Matrieh near Cairo, April 2, 1900.
In sand ----------------------- Wadi Dugla near Cairo, Apr. 22, 1902.
In sand ----------------------- between Cairo and Deir-el-Beda, date ?.

Uncinula nectator (Schw.) Burr.
On Vitis sp. -------------------- Shubra-el-Namla, Nov. 13, 1927. L. E. M. et al.
On Vitis sp. -------------------- Ezbet Khorshid, Aug. 26, 1929. S-el-D.

Uredo coloni I. Reichert
On Panicum colonum Linn. ------- Beni Suef, Jan, 1822-25.

Uredo cyperi-alopecuroidis I. Reichert
On leaves of Cyperus alopecuroides Rottb. ---------------------- Mansura, Dec. 9, 1911.

Uredo cypericola P. Henn.
On Cyperus difformis Linn. ------- Kafr-el-Shiekh, Nov. 4, 1827. L. E. M. et al.
On Cyperus difformis Linn. ------- Mansura, Oct. 31, 1927. L.E.M. et al.
On Cyperus difformis Linn. ------- Mit Dafer, Oct. 30, 1927. L.E.M. et al.
On Cyperus difformis Linn. ------- Giza, Oct., 1928.[1] L. E. M. et al.

1. According to determination of R. W. Davidson who believes it close to Puccinia romagnoliana.

Uredo danthoniae P. Henn.	
On leaves of Danthonia forskalii Trin.	Quatyeh station, Apr. 25, 1902.
Uredo euphorbiae-prunifoliae I. Reichert	
On leaves of Euphorbia prunifolia Jacq.	Mansura, Dec. 8, 1811.
Uredo fici Cast. (See Cerotelium fici)	
On Ficus carica Linn.	Egypt, 1920-22. B. J.
On Ficus carica Linn.	Egypt, 1923. T. F.
Uredo reaumuriicola P. Henn.	
On leaves of Reaumuria mucronata Faub. & Spach.	Heluan, Mar., 1899.
On leaves of Reaumuria mucronata Faub. & Spach.	Wadi Ghisi south Galala, date ?
Uredo zygophylli P. Henn.	
On leaves and stems of Zygophyllum decumbens Delile	Egypt, May 1922-25.
Urocystis tritici Koern.	
On Triticum sp.	Egypt, 1923. T. F.
On Triticum sp.	Egypt, 1927. L. E. M. et al.
On Triticum sp.	Kallin, Feb., 1928. L. E. M. et al.
On Triticum sp.	Menoufieh, Feb. 10, 1928. L.E.M. et al.
On Triticum sp.	Telwana, Feb. 14, 1928. L.E.M. et al.
On Triticum sp.	Mansura, Jan. 3, 1928. L.E.M. et al.
Uromyces anthyllidis (Grev.) Schrot.	
On Lotus arabicus Linn.	Alexandria, May 2, 1890.
On Lotus glinoides Delile	Alexandria, April 17, 1912.
On Lotus villosus Forsk.	Abukir, Apr. 17, 1912.
On Lotus villosus Forsk.	Damietta, Apr. 17, 1912.
On Trigonella foenum-graecum Linn.	near Abuksa Fayoum, Apr., 1879.
On Trigonella foenum-graecum Linn.	Alexandria, date?.
On Trigonella occulta Delile	Quatyeh Sta., Apr. 23, 1902.
Uromyces appendiculatus (Pers.) Link	
On Phaseolus vulgaris Linn.	Egypt, 1920-22. B. J.
On Phaseolus vulgaris Linn.	Ras-el-Khalig, Nov. 1, 1927. L. E. M. et al.
On Phaseolus vulgaris Linn.	Barrage, Egypt, Nov. 12, 1927. L. E. M. et al.
On Vigna sinensis Endl. (Erroneous report)	Egypt, 1920-22. B. J.

Uromyces astragali (Opiz) Sacc.
On Astragalus tomentosus Lam. -- Rosetta, Mar., 1822-25.

Uromyces chenopodii (Duby) Schr.
On Suaeda vera Forsk. in salt swamps ---------------------- near Salehieh in Wadi Tumilat, May, 1880.

Uromyces fabae (Pers.) DeBary
On Vicia faba L. ---------------- Egypt, 1920-22. B. J.
On Vicia faba L. ---------------- Egypt, 1923. T. F.
On Vicia faba L. ---------------- Cairo, date ?.
On Vicia faba L. Widely spread where crop is grown. ----------- Egypt, Aug. 1928. L.E.M. et al.
On Vicia sativa L. --------------- Damietta, Apr. 20, 1912.

Uromyces linearis B. & Bp.
On Panicum repens L. ----------- Mansura, date ?.

Uromyces medicaginis Pass.
On Medicago sativa Linn. --------- Birket-el-Sab, 1880.
On Medicago sativa Linn. --------- Abu Korkas, Nov. 23, 1927. L. E. M. et al.
On Medicago sativa Linn. --------- Giza, Nov., 1928. L. E. M. et al.

Uromyces polygoni (Pers.) Fuck.
On Polygonum bellardi All. ------- near Tell-el-Kebir in Wadi Tumilat, May, 1880.
On Polygonum bellardi All. ------- El-Marg near Cairo, Apr. 28, 1908.

Uromyces renovatus Sydow
On leaves of Lupinus digitatus Forsk. ------------------------ Fayoum, date ?.

Uromyces rumicis (Schum.) Wint.
On Rumex dentatus Linn. --------- near Gassatin in Wadi Tumilat, May, 1880.

Uromyces schanginiae Thuem.
On leaves of Schanginia baccata Moq. ------------------------- Damietta, July, 1876.
On leaves of Schanginia hortensis Moq. ------------------------- Fort Sulkowski near Cairo, May, 1880.

Uromyces scillarum (Grev.) Wint.
On Urginea maritima Baker ------- Egyptian-Syrian desert, Mar. 23, 1880.

Uromyces scirpi (Cast.) Burr.
On Scirpus maritimus Linn. ------- Damietta, Date ?.
Habitat ? ---------------------- Alexandria, date ?.
Habitat ? ---------------------- Zagazig, date ?.

Uromyces setaria-italicae (Diet.) Yosh.
On Setaria viridis Beauv. --------- Mariout Distr., Oct. 15, 1928. L. E. M. et al.

Uromyces striatus Schroet.	
On Medicago ciliaris Krock	Damietta, Apr. 20, 1912.
On Medicago sativa Linn.	Birket-el-Sab, date ?.
On Medicago sativa Linn.	Abu Korkas, Nov. 23, 1927. L. E. M. et al.
Uromyces vignae A. Barclay	
On Vigna sinensis Endl.	Egypt, 1924-25.
On Vigna sinensis Endl.	Ras-el-Khalig, Nov. 1 L. E. M. et al.
On Vigna sinensis Endl.	Barrage, Dec., 1928. L. E. M. et al.
Ustilago aegyptiaca Fischer v. Waldh.	
On Schismus calycinus Coss.	Cairo, 1822-25.
On Schismus calycinus Coss.	Quatyeh, Apr. 29, 1887.
On Schismus calycinus Coss.	Mokattam, Cairo, May 7, 1908.
Ustilago aschersoniana Fischer v. Waldh.	
On Festuca memphitica Boiss.	Rosetta, Mar. 1820-24.
On Scleropoa memphitica Boiss.	In the little oases, Quacr-Bauiti, Libyan Desert, April, 1886.
On Scleropoa memphitica Boiss.	Qugah, Apr. 29, 1887.
On Scleropoa memphitica Boiss.	near pyramids, Giza, May 3, 1908.
On Scleropoa memphitica Boiss.	Rosetta, date ?.
Ustilago avenae (Pers.) Jens.	
On Avena sterilis Linn.	Tel-el-Kebir, 1880.
Ustilago bromivora (Tul.) Fischer v. Wald.	
On Brachypodium distachyum Beauv.	Alexandria, date ?.
On Bromus fasciculatus Presl.	Near Amria, Apr. 13, 1908.
On Bromus fasciculatus Presl.	Cairo, Mar., 1920-24.
Ustilago cynodontis P. Henn.	
On Cynodon dactylon Pers.	Cairo and Saman, Mar., 1822-25.
On Cynodon dactylon Pers.	Deldhelah near Alexandria, date ?.
On Cynodon dactylon Pers.	Abu Zabal, Apr. 1, 1880.
Ustilago digitariae (Kunze) Rabh.	
On Panicum repens Linn.	Menzaleh Lake, July 10, 1877.
On Panicum sanguinale Linn.	Cairo date ?.
Ustilago ehrenbergiana F. de Welsh.= **Ustilago schumanniana** P. Henn.	
On Aegilops bicornis Jaub. & Spach	Rosetta, Mar., 1820-24.
Ustilago hordei (Pers.) Kell. & Sw.	
On Hordeum vulgare Linn.	Beni Suef, date ?.
On Hordeum vulgare Linn.	Bulak near Cairo, March, 1874.
On Hordeum vulgare Linn.	Egypt, 1920-22. B. J.
On Hordeum vulgare Linn.	Egypt, 1923. T. F.

On Hordeum vulgare Linn.	Gemmaiza farm, 1928. L.E.M. et al.
Ustilago hypodytes (Schl.) Fr.	
On Diplachne fusca Beauv.	Bilbeis, May, 1880.
On Diplachne fusca Beauv.	San, date ?.
On Festuca fusca Linn.	Egypt, April, 1820-24.
Ustilago ischaemi Fuck.	
On Pennisetum dichotomum Delile	Cairo, desert Basettin, May, 1920-24.
Ustilago lepturi (Thum.) P. Henn.	
On Lepturus incurvatus Trin.	Damietta, Apr., 1876.
Ustilago levis (Kell & Sw.) Magnus	
On Avena sterilis Linn.	Alexandria, Mariout region, date ?.
Ustilago lolii P. Magnus	
On Lolium temulentum Linn.	Mariout Lake, Amria, Apr. 13, 1908.
Ustilago nuda (Jens.) Kell. & Sw.	
On Hordeum vulgare Linn.	Mariout near Alexandria, date ?.
On Hordeum vulgare Linn.	Assuit, Aug., 1864.
On Hordeum vulgare Linn.	Quan-el-Gharbi, and Esleh?, Mar. 9, 1864.
On Hordeum vulgare Linn.	Egypt, 1920-22. B. J
On Hordeum vulgare Linn.	Egypt, 1923. T. F.
On Hordeum vulgare Linn.	Egypt, 1928. L. E. M. et al.
Ustilago penniseti Rabh.	
On Panicum dichotomum Forsk.	Wadi Risched, May 3, 1893.
Ustilago phoenicis Cda.	
On Phoenix dactylifera Linn.	Cairo, Jan., 1876.
Ustilago reiliana Kuehn.	
Habitat ?	Egypt, 1874.
On Andropogon sorghum Brot.	Egypt, 1920-22. B. J.
Ustilago schumanniana P. Henn.	
On Aegilops bicornis Jaub. & Spach	Rosetta, Mar., 1822-25.
Ustilago tricholaenae P. Henn.	
On Tricholaena teneriffa Parl.	Wadi Chafura, Mar., 1880.
Ustilago trichophora (Link) Kze.	
On Panicum colonum Linn.	Egypt, 1820-24.
Ustilago tritici (Pers.) Jens.	
On Triticum durum Desf.	Assuit, Mar. 10, 1893.
On Triticum spelta Linn.	Zagazig, May 15, 1888.
On Triticum vulgare Desf.	Damietta, date ?.
On Triticum vulgare Desf.	Kharga Oasis, Mar., 1874.
On Triticum vulgare Desf.	Assuit, Mar. 10, 1893.
On Triticum spp.	Egypt, 1920-22. B. J.
On Triticum spp.	Egypt, 1923. T. F.
On Triticum spp.	Egypt in general, Feb., 1928.[1] L. E. M. et al

1. Occurs in practically every wheat field. From trace to 12 per cent infection.

On Triticum spp. ---------------- Egypt in general, Feb., 1929. L. E. M. et al.

Ustilago vaillantii Tul.

In anthers of Hyacinthus mauritanicus Th. Dur. & Schinz. -------- Mariout district, Mar., 1880.

Ustilago vaillantii Tul. v. tourneuxii Fischer v. Waldh.

In anthers of Hyacinthus mauritanicus Th. Dur. & Schinz. --------- Alexandria, date ?.

Ustilago zeae (Beckm.) Ung.

On Zea mays Linn. -------------- Egypt, 1924-25, S -el -D.

Vermicularia culmifraga Fr.

On Imperata cylindrica Beauv. --- El-Marg, Apr. 27, 1908.

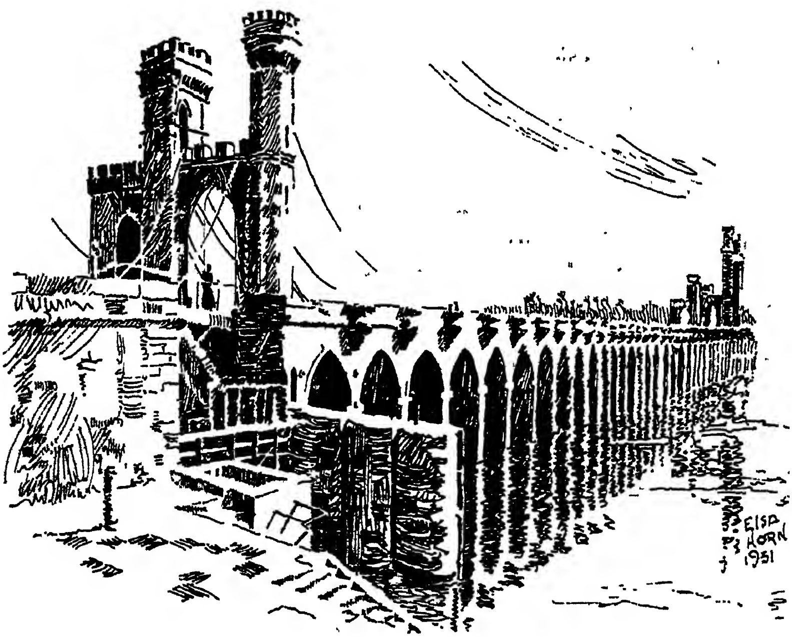
Volvaria speciosa Fr.

In gardens ---------------------- Rhoda, Cairo, Jan., 1890.

Xylaria hypoxylon (L.) Grev.

On wood near spring ------------ Cairo, Oct., 1871.

In botanical garden -------------- Cairo, 1871.



HOST-ORGANISM ARRANGEMENT

Acacia farnesiana Willd.	
Cladosporium acaciae I. Reichert	Rhoda and Kahiram, Feb., 1822-25.
Achillea santolina Linn.	
Puccinia santolinae P. Magnus	Near Amria, Apr. 13, 1908.
Aegilops bicornis Jaub. & Spach	
Ustilago ehrenbergiana F. de Waldh.=Ustilago schumanniana P. Henn.	Rosetta, Mar., 1820-24.
Ustilago schumanniana P. Henn.	Rosetta, Mar., 1822-25.
Alhagi maurorum Medic.	
Oidiopsis sp.	Kharga oasis, Jan. 9, 1929. L. E. M. and M. B.
Allium cepa Linn.	
Botrytis cinerea Pers.	In markets, Hamburg, Germany, 1909.
Peronospora schleideni Ung.	Egypt, 1923. T. F.
Peronospora schleideni Ung.	Khorkania, Apr. 19, 1928. M. B.
Allium sativum Linn.	
Puccinia allii (DC.) Rudolphi	Alexandria, July 27, 1928. L.E.M. et al.
Alsine procumbens Fenzl.	
Pleospora aegyptiaca I. Reichert	Alexandria, Sept., 1821-25.
Alsine sp.	
Peronospora alsinearum Casp.	Fayoum, Dec., 1879.
Ammi majus Linn.	
Oidium erysiphoides Fr.	Assuit, Mar., 1893.
Amygdalus communis Linn.	
Puccinia pruni-spinosae Pers.	Egypt, 1920-22, B. J.
Puccinia pruni-spinosae Pers.	Egypt, 1923. T. F.
Tranzschelia punctata (Pers.) Arth. =Puccinia pruni-spinosae Pers.	Rafah, May 25, 1928, L.E.M. et al.
Amygdalus persica Linn.	
Exoascus deformans (Berk.) Fuck.	Egypt, 1920-22. B. J.
Sphaerotheca pannosa (Wallr.) Lev.	Lower Egypt, 1924-25.
Sphaerotheca pannosa (Wallr.) Lev.	Fayoum, May 12, 1928. M. B.
Sphaerotheca pannosa (Wallr.) Lev.	Beni Suef, May 15, 1928. M. B.
Tranzschelia punctata Pers.) Arth. =Puccinia pruni-spinosae Pers.	Tanta, Nov. 13, 1927. L.E.M. et al.
Tranzschelia punctata Pers.) Arth.	Giza, Oct. 18, 1928. L.E.M. et al.
Tranzschelia punctata Pers.) Arth.	Korashia, Oct. 30, 1928. L.E.M. et al.
Anabasis articulata Moq.	
Coniothyrium diedickeanum I. Reich.	Kahiram, Nov., 1820-25.
Macrophoma engleriana I. Reichert	Kahiram, 1822-25.

Andropogon annulatus Forsk.
Fusarium uredinicola J. Mueller
In sori of Puccinia cesatii Schroet. Suez, date ?.
Puccinia cesatii Schroet. ---------- Cairo, Apr., 1822-25.
Puccinia cesatii Schroet. ---------- Heliopolis, Apr. 25, 1908
Puccinia cesatii Schroet. ---------- Giza, May 4, 1908.

Andropogon foveolatus Delile
Cladosporium gramineum Corda -- El Tor, date ?.
Sphacelotheca ischaemi (Fuck.) Clinton ---------------------- Suez, May 20, 1908.

Andropogon sorghum Brot.
Puccinia purpurea Cke. ----------- Damietta, Mar., 1822-25.

Andropogon sorghum Brot.
Bacterium marginale Brown, N. -- Cairo, Jan., 1927. L. E. M. et al.
Sorosporium ehrenbergii J. Kuehn Cairo and Damietta, July, 1876.
Sphacelotheca reiliana (Kuehn) Clint.=Sorosporium reilianum (Kuehn) McAlp. -------------- Sakkarah, June 17, 1868.
Sphacelotheca reiliana (Kuehn) Clint.=Sorosporium reilianum (Kuehn) McAlp. -------------- Cairo, 1869, Reil.
Sphacelotheca reiliana (Kuehn) Clint.=Sorosporium reilianum (Kuehn) McAlp. -------------- Assuan, Jan. 6, 1907.
Sphacelotheca reiliana (Kuehn) Clint.=Sorosporium reilianum (Kuehn) McAlp. -------------- Assuit, Dec. 25, 1908.
Sphacelotheca sorghi (Link) Clint. Cairo, date ?.
Sphacelotheca sorghi (Link) Clint. Egypt, 1920-22. B. J.
Sphacelotheca sorghi (Link) Clint. Egypt, 1923. T. F.
Tolyposporium filiferum Busse ---- Egypt, 1920-22. B. J.
Tolyposporium filiferum Busse ---- Egypt, 1923. T. F.
Tolyposporium filiferum Busse ---- Fayoum, Nov. 24, 1927. L.E.M. et al.
Tolyposporium filiferum Busse ---- Kena, Assuit, 1928. L. E. M. et al.
Ustilago reiliana Kuehn ---------- Egypt, 1920-22. B. J.

Anethum graveolens Linn.
Cercospora sp. ------------------ Birket-el-Sab, Dec. 10, 1928. Y. F.

Apium graveolens Linn.
Cercospora apii Fr. -------------- Egypt, 1920-22. B. J.
Cercospora apii Fr. -------------- Giza, Oct. 16, 1927. Y. F.

Arachis hypogaea Linn.
Cercospora personata (B. & C.) Ell. & Ev. ------------------- Bilbeis, Oct. 27, 1927. L. E. M. et al.
Neocosmospora vasinfecta (Atk.) EFS. ----------------------- Sharkia, Aug. 13, 1928. R. M. N.

Rhizoctonia spp. ---------------- Egypt, 1920-22. B. J.

Aristida acutiflora Trin. & Rupr.

Puccinia aristidicola P. Henn. ---- Reia Behera, Apr. 15, 1898.

Aristida scoparia Trin. & Rupr.

Puccinia aristidae Tracy --------- Station Quatyeh, Apr. 25, 1902.

Puccinia aristidicola P. Henn. ----- West of Reia Behera, Apr. 15, 1898.

Artemisia herba-alba Asso

Puccinia absinthii DC. ----------- In desert of Piorali, Egypt, date ?.

Asphodelus microcarpus Viviani

Pleospora asphodeli Rabenh. ------ Egypt, Sept. & Oct., 1822-25.

Asphodelus viscidulus Boiss.

Puccinia barbeyi (Roum.) P. Magn. Rafa, May 25, 1928. L. E. M. et al.

Asphodelus sp.

Puccinia asphodeli Moug. --------- Alexandria, date ?.

Astragalus fruticosus Forsk.

Cladosporium herbarum (Pers.) Link ------------------------ Rosetta, 1901 (?).

Astragulus tomentosus Lam.

Uromyces astragali (Opiz) Sacc. -- Rosetta, Mar., 1822-25.

Atriplicis sp.

Glonium guttulatum I. Reichert -- Abukir, Sept., 1822-25.

Avena sativa Linn.

Puccinia graminis Pers. ---------- Egypt, 1920-22. B. J.

Puccinia graminis Pers. ---------- Gebal-el-Qslar, Apr. 2, 1928. L. E. M. et al.

Avena sterilis Linn.

Ustilago avenae (Pers.) Jens. ---- Gel-el-Kebir, 1880 (?).

Ustilago levis (Kell. & Sw.) Magnus ------------------------- Alexandria, Mariout region, date ?.

Beta vulgarus Linn.

Cercospora beticola Sacc. -------- Egypt, 1920-22. B. J.

Cercospora beticola Sacc. -------- Egypt, 1923. T. F.

Brachypodium distachyum Beauv.

Ustilago bromivera (Tul.) Fischer v. Wald. --------------------- Alexandria, date ?.

Brassica campestris Linn.

Alternaria brassicae (Berk.) Sacc. Egypt, 1920-22. B. J.

Brassica napus Linn.

Albugo candida (Pers.) O. Kunze - Damietta, Mar., 1877.

Brassica nigra Koch

Albugo candida (Pers.) O. Kunze - Cairo, Mar., 1877.

Brassica oleracea Linn.

Peronospora parasitica (Pers.) De Bary ------------------------ Egypt, 1920-22. B. J.

Peronospora parasitica (Pers.) De Bary ------------------------ Egypt, 1923. T. F.

Rhizoctonia spp. ---------------- Egypt, 1920-22. B. J.

Bromus fasciculatus Presl.

Ustilago bromivora (Tul.) Fischer v. Wald. -------------------- Near Amria, Apr. 13, 1908.

Ustilago bromivora (Tul.) Fischer v. Wald. -------------------- Cairo, Mar. 1920-24.

Bromus villosus Forsk.

Puccinia bromina Erikss. -------- Sidi-Gaber near Alexandria, Apr. 7, 1908.

Calligonum comosum L'Herit.

Hormiscium calligoni I. Reichert -- Bir Haie and Bir Lebek, Dec., 1822-25.

Capsicum sp.

Oidiopsis taurica (Lev.) Salm. ---- Alexandria, Giza, Feb., 1927. L. E. M. et al.

Oidiopsis taurica (Lev.) Salm. ---- Beni Suef, Nov. 26, 1927. L.E.M. et al.

Oidiopsis taurica (Lev.) Salm. ---- Mansura, Oct. 31, 1927. L. E. M. et al.

Ramularia sp. ------------------ Mansura, Oct. 15, 1927.[1] L.E.M. et al.

Carex divisa Huds.

Puccinia caricis (Schum.) Rebent. - El-Marg, Cairo, Apr. 27, 1908.

Carica papaya Linn.

Cephalothecium roseum Cda. ----- Giza laboratory, 1930. H. S. Fawcett.

Carthamus tinctorius Linn.

Puccinia carthami (Hutzelm.) Cda. Cairo, date ?.

Puccinia carthami (Hutzelm.) Cda. Giza, June 12, 1887.

Centaurea calcitrapa Linn.

Puccinia calcitrapae DC. -------- Mansura, Mar., 1822-25.

Puccinia calcitrapae DC -------- Alexandria, Jan., 1822-25

Puccinia calcitrapae DC. -------- Mit Kamo, Apr., 1822-25.

Puccinia calcitrapae DC. -------- Benha, June 20, 1885.

Centaurea napifolia Linn.

Puccinia verruca Thuem. --------- Upper Egypt, date ?.

Centaurea sp.

Puccinia centaureae DC. ---------- Near Alexandria, date ?.

Citrullus vulgaris Schrad.

Erysiphe cichoracearum DC. ------ Egypt, 1924-25.

Fusarium spp. (Wilt) ----------- Lower and middle Egypt, 1924-25.

Fusarium spp. (Wilt) ----------- Giza Prov., 1928. L. E. M. et al.

Plasmopara cubensis (B. & C.) Humph. -------------------- Egypt, 1923. T. F.[2]

Plasmopara cubensis (B. & C.) Humph. -------------------- Egypt, 1924-25. T. F.

Rhizoctonia spp. ---------------- Egypt, 1920-22. B. J.

Citrus aurantifolia Sw.

1. Seems to be a new species of Ramularia. L. E. M.
2. This should be Pseudoperonospora cubensis (B. & C.) Humphrey.

Alternaria sp. ------------------ Damanhour, Sept. 15, 1928.[1] L. E. M. et al.

Citrus medica Linn.

Diplodia warburgiana I. Reichert - Cairo (Rhoda), Feb., 1822-25.

Citrus sp.

Alternaria citri N. B. Pierce ------ Egypt, 1920-22. B. J.
Alternaria citri N. B. Pierce ------ Egypt, 1923. T. F.
Alternaria sp. ------------------ Egypt, 1930. H. S. Fawcett.
Capnodium citricolum McAlp. ----- Egypt, 1920-22. B. J.
Colletotrichum gloeosporioides Penz Egypt prior to 1913.
Colletotrichum gloeosporioides Penz All over Egypt, 1920-22. B. J.
Colletotrichum gloeosporioides Penz. Egypt, 1923. T. F.
Colletotrichum gloeosporioides Penz All over Egypt, 1927. L. E. M. & M. B.
Colletotrichum gloeosporioides Penz. All over Egypt, 1928. L.E.M. & M. B.
Colletotrichum gloeosporioides Penz. All over Egypt, 1929. L.E.M. & M. B.
Fomes lucidus (Leys.) Fr. -------- Egypt, 1889.
Fusarium solani (Mart.) Sacc. -- - Egypt, 1924-25. S -el -D.
Penicillium digitatum (Fr.) Sacc. Egypt, 1920-22. B. J.
Penicillium digitatum (Fr.) Sacc. - Egypt, 1930. H. S. Fawcett.
Penicillium italicum Wehmer ----- Egypt, 1920-22. B. J.
Penicillium italicum Wehmer ----- Egypt, 1930. H. S. Fawcett.
Phomopsis citri Fawc. ----------- Egypt, 1920-22. B. J.
Phomopsis citri Fawc. ----------- Egypt, 1923. T. F.
Pythiacystis citrophthora Sm. &.Sm. Egypt, 1920-22. B. J.
Pythiacystis citrophthora Sm. &.Sm. Egypt, 1923. T. F.
Pythiacystis citrophthora Sm. &.Sm. Egypt, 1927. M. B. & S -el -D.
Pythiacystis citrophthora Sm. &.Sm. Egypt, 1928. M. B.
Pythiacystis citrophthora Sm. &.Sm. Egypt, 1930. S -el -D.[1]
Pythiacystis citrophthora Sm. &.Sm. Egypt, 1930. H. S. Fawcett.

Convolvulus (? arvensis Linn.)

Erysiphe (? communis (Wallr.) Fr) Dakahlieh, Nov., 1927. L.E.M. et al.

Corchorus olitorius Linn. (Meloukia)

Cercospora sp. ------------------ Tanta, Nov. 13, 1927. L. E. M. et al.

Coronopus niloticus Spreng.

Albugo candida (Pers.) O. Kunze -- Between Alexandria & Cairo, 1820-25.

Cressa cretica Linn.

Puccinia cressae (DC.) Lagh. ----- Alexandria, Mar., 1822-25.
Puccinia cressae (DC.) Lagh. ----- In rice fields near Alexandria, May 13, 1874.
Puccinia cressae (DC.) Lagh. ----- Near Damietta, July, 1876.
Puccinia cressae (DC.) Lagh. ----- Near Abukir, Mar. 23, 1877.
Puccinia cressae (DC.) Lagh. ----- Near Fayoum, May, 1884.
Puccinia cressae (DC.) Lagh. ----- Heluan, date ?.
Puccinia cressae (DC.) Lagh. ----- In desert near Suez, date ?.
Puccinia cressae (DC.) Lagh. ----- Near Baltim, Apr. 5, 1887.

1. The first time it has been definitely cultured and determined in Egypt.

Puccinia cressae (DC.) Lagh. ----- Wadi Weheya, Nov. 1, 1928. L.E.M.
Puccinia cressae (DC.) Lagh. ----- Near Sidi Galem near Parbieh, date ?.

Cucumis sativus Linn.
Erysiphe cichoracearum DC. ------ Giza, Jan., 1928. L. E. M. et al.
Erysiphe cichoracearum DC. ----- Barrage, May 11, 1928. L.E.M. et al.

Cucumis sp.
Macrosporium commune Rabenh. (On decayed melons) ---------- Cairo, 1901 (?).
Macrosporium cucumerium Ell. & Ev. ---------------------- Rafah, May 25, 1928. L. E. M. et al.

Cucurbita laginaria Linn.
Erysiphe cichoracearum DC. ----- Egypt, 1920-22. B. J.
Erysiphe cichoracearum DC. ----- Giza, Alexandria, 1928. L.E.M. et al.

Cucurbita pepo v. condensa Bailey
Erysiphe cichoracearum DC. ------ (Oidum stage only) ----------- Fayoum, Nov. 22, 1927. L. E. M. et al.

Cucurbita sp.
Erysiphe cichoracearum DC. ------ Beni Suef, Nov. 26, 1927. L.E.M. et al.
Erysiphe cichoracearum DC. ------ Beni Hassan, Nov. 22, 1927. L. E. M. et al.
Rhizoctonia spp. (on pumpkin) --- Egypt, 1920-22. B. J.

Cynanchum acutum Linn.
Fusicladium cynanchi I. Reichert -- Damietta, April, 1822-25.

Cynara scolymus Linn.
Sclerotium rolfsii Sacc. ---------- Egypt, 1920-22. B. J.
Sclerotium rolfsii Sacc. ---------- Egypt, 1923. T. F.
Sclerotium rolfsii Sacc. ---------- Barrage, Nov., 1927. L.E.M. et al.

Cynodon dactylon Pers.
Darluca filum (Bivon.) Cast. ----- (In uredosori) San, Mar., 1822-25.
Lepiota holosericea Fr. ----------- Alexandria (Ramleh), Nov., 1910.
Lepiota holosericea Fr. ----------- West Cairo, Dec., 1910.
Lepiota holosericea Fr. ----------- Cairo, Nov. 25, 1913.
Phyllachora cynodontis (Sacc.) Niessl. ---------------------- Cairo, Apr., 1872.
Phyllachora cynodontis (Sacc.) Niessl. ---------------------- Alexandria, Apr. 7, 1908.
Phyllachora cynodontis (Sacc.) Niessl. ---------------------- Cairo, Apr. 27, 1908.
Ustilago cynodontis P. Henn. ----- Cairo and Saman, Mar., 1822-25.
Ustilago cynodontis P. Henn. ----- Deldhelah near Alexandria, date ?.
Ustilago cynodontis P. Henn. ----- Abu Zabal, Apr. 1, 1880.

Cyperus alopecuroides Rottb.
Uredo cyperi-alopecuroidis I. Reichert ------------------------ Mansura, Dec. 9, 1911.

Cyperus auricomus Sieber
Phyllachora ehrenbergii I. Reichert Machsamah, Apr. 25, 1887.

Cyperus difformis Linn.
Uredo cypericola P. Henn. -------- Kafr-el-Shiekh, Nov. 4, 1927. L. E. M. et al.
Uredo cypericola P. Henn. -------- Mansura, Oct. 31, 1927. L.E.M. et al.
Uredo cypericola P. Henn. -------- M't Dafer, Oct. 30, 1927. L.E.M. et al.
Uredo cypericola P. Henn. -------- Giza, Oct., 1928.[1] L. E. M. et al.

Cyperus radiatus Vahl.
Phyllachora ehrenbergii I. Reichert Damietta, Apr., 1822-25.

Dalbergia melanoxylon Guill. & Perr.
Fumago vagans Pers. ------------ Cairo (Shubra), date ?.

Danthonia forskalii Trin.
Cintractia algeriensis Pat. ------- Sand hills Rosetta, July, 1880.
Uredo danthoniae P. Henn. ------- Quatyeh station, Apr. 25, 1902.

Daucus carota Linn.
Rhizoctonia spp. ---------------- Egypt, 1920-22. B. J.

Diospyros sp.
Bacterium tumefaciens EFS.=Pseudomonas tumefaciens EFS. & Towns. ---------------------- Egypt, 1924-25.

Diplachne fusca Beauv.
Ustilago hypodytes (Schl.) Fr. -- Bilbeis, May, 1880.
Ustilago hypodytes (Schl.) Fr. -- San, date ?.

Diplotaxis harra Boiss.
Albugo candida (Pers.) O. Kunze Mokattam Hills, May 2, 1908.

Echinops spinosus Linn.
Puccinia pulvinata Rbh. ---------- Alexandria, Mar., 1822-25.

Elionurus hirsutus Munro
Sorosporium desertorum Thuem. -- Wadi Gudeli, April, 1879.
Sorosporium desertorum Thuem. -- North Arabian Desert, Wadi Chafura, Apr. 9, 1880.

Eragrostis bipinnata Muschler
Puccinia cynosuroides (P. Henn.) Sydow ------------------------ Port Said, Nov. 19, 1901.

Erodium glaucophyllum Ait.
Gloeosporium schweinfurthianum Thuem. ---------------------- Cairo (Wadi Dugla), May, 1879.

Eryngium campestre Linn.
Puccinia eryngii DC. ------------ Bir Kres, Mar., 1822-25.

Eryngium sp.
Puccinia eryngii DC. ------------ Near Mex, 1901 (?).

Euphorbia arguta Soland
Melampsora helioscopiae Winter -- Bahtim (near Cairo), Apr. 13, 1912.

1. According to determination of R. W. Davidson who believed it close to Puccinia romagnoliana.

Euphorbia cornuta Pers.	
Melampsora euphorbiae (Schub.) Cast.	Dakahlia Prov., Nov. 4, 1927. L. E. M. et al.
Melampsora euphorbiae (Schub.) Cast.	El Arish, Mar. 21, 1928. L.E.M. et al.
Melampsora euphorbiae-gerardianae W. Mueller	El Arish and Foqirah, May 6, 1887.
Euphorbia peploides Gouan.	
Melampsora helioscopiae Winter	Bahtim (near Cairo), Apr. 13, 1912.
Euphorbia peplus Linn.	
Melampsora euphorbiae (Schub.) Cast.	Damietta, Apr., 1822-25.
Melampsora euphorbiae (Schub.) Cast.	Adneh in Fayoum, Mar., 1879.
Euphorbia prunifolia Jacq.	
Clathrococcum magnusianum I. Reichert	Salamum near Mansura, date ?.
Macrosporium euphorbiae I. Reichert	Near Salamum and Mansura, Dec. 6. 1911.
Euphorbia punctata Delile	
Aecidium euphorbiae Schw.= Uromyces proeminens (DC.) Pass.	Hatieh Oasis, Egyptian-Syrian desert, 1881 ?.
Euphorbia spp.	
Melampsora euphorbiae (Schub.) Cast.	Kasr Dachl, Mar. 10, 1874.
Melampsora euphorbiae (Schub.) Cast.	Heliopolis, Mar. 12, 1880.
Festuca dertonensis Aschers. & Graeb.	
Puccinia paraphysata I. Reichert	Egypt, May, 1910.
Festuca fusca Linn.	
Ustilago hypodytes (Schl.) Fr.	Egypt, April, 1820-24.
Festuca memphitica Boiss.	
Ustilago aschersoniana Fischer v. Waldh.	Rosetta, Mar., 1820-24.
Ficus carica Linn.	
Kuehneola fici Butl.	Alexandria (Ramleh), Dec., 1879.
Lentinus integrus I. Reichert	Alexandria, Dec., 1908.
Uredo fici Cast. (see Cerotelium fici)	Egypt, 1920-22. B. J.
Uredo fici Cast. (see Cerotelium fici)	Egypt, 1923. T. F.
Ficus sycomorus Linn.	
Pleurotus ficicola Mont.	Egypt, date ?.

Pterophyllus bovei Lev.=
Pleurotus ficiola Mont. ---------- Egypt, 1844.

Ficus sp. (fig)
Cerotelium fici (Cast.) Arth. ------ Alexandria, Dec. 22, 1927. L.E.M. et al.
Cerotelium fici (Cast.) Arth. ------ Giza, Hort. Farm, Oct. 18, 1928. L. E. M. et al.
Cerotelium fici (Cast.) Arth. ------ Sidi Garber, Dec. 21, 1928. L.E.M. et al.

Foeniculum vulgare Mill.
Erysiphe polygoni DC. ---------- Egypt, 1923. T. F.

Fragaria sp.
Mycosphaerella fragariae (Schwein.) Lind. -------------- Egypt, 1920-22. B. J.

Frankenia pulverulenta Linn.
Puccinia frankeniae Link -------- Sserssena near Fayoum, Mar., 1879.
Puccinia frankeniae Link -------- East of Damietta, Apr. 17, 1902.

Galera rubiginosa (Pers.) Sacc.
Hypomyces galericola P. Henn. --- Cairo, Apr. 15, 1902.

Gelsemium sp.
Botrytis sp. -------------------- Alexandria, July 9, 1928. M. B.

Glycyrrhiza glabra Linn.
Oidiopsis taurica (Lev.) Salm. ---- Baharia oasis, Oct., 1928. R.M.N.

Gossypium barbadense Linn.
Bacterium malvacearum EFS. ---- Egypt, 1920-22. B. J.
Bacterium malvacearum EFS. ---- Mit Dafer, Oct. 31, 1927. L.E.M. et al.
Bacterium malvacearum EFS. ---- Egypt, 1928. L. E. M. et al.
Corticium vagum Berk. & Curt. --- Egypt, 1923. T. F.
Cyathus stercoreus (Schwein.) De Toni=Nidularia stercorea Schwein. Shirbin, Oct. 25, 1909.
Fusarium spp. ------------------ Egypt. 1920-22. B. J.
Fusarium spp. ------------------ Egypt, 1923. T. F.
Fusarium spp. ------------------ Parts of Middle and Lower Egypt, 1927. L. E. M. et al.
Fusarium spp. ------------------ In numerous areas Delta, Oct., 1927. L. E. M. et al.
Fusarium spp. ------------------ Middle and Lower Egypt, 1928. L. E. M. et al.
Fusarium spp. ------------------ Middle and Lower Egypt, 1929. L. E. M. et al.
Neocosmospora vasinfecta (Atk.) EFS. ------------------------ Various places in Egypt, date ?.
Phyllosticta gossypina Ell. & Mart. Gemmaiza, Oct. 16, 1927. L.E.M.
Pythium debaryanum Hesse ------- Giza, 1905. W. Balls.
Rhizoctonia spp. --------------- Egypt, 1920-22. B. J.
Rhizoctonia spp. --------------- Egypt, 1927. L. E. M. et al.
Rhizoctonia spp. --------------- Egypt, 1928. L. E. M. et al.

Rhizoctonia spp.	Egypt, 1929. L. E. M. et al.
Rhizopus nigricans Ehr.	Egypt, 1920-22. B. J.
Rhizopus nigricans Ehr.	Egypt, 1923. T. F.
Sporodesmium longipedicellatum I. Reichert	Bahtim, Aug. 15, 1912.
Helianthus annuus Linn.	
Puccinia helianthi Schw.	Egypt. 1924-25.
Puccinia helianthi Schw.	Giza, May 10, 1927. L. E. M. et al.
Puccinia helianthi Schw.	Giza, July 17, 1928. L. E. M. et al.
Hibiscus cannabinus Linn.	
Oidiopsis taurica (Lev.) Salm.	Egypt, 1920-22. B. J.
Oidiopsis taurica (Lev.) Salm.	Giza, Sept., 1929. R. M. N.
Hibiscus esculentus Linn.	
Cladosporium hibisci I. Reichert	Assuit, Oct., 1822-25.
Erysiphe cichoracearum DC.	Egypt, 1920-22. B. J.
Erysiphe cichoracearum DC.	Egypt, 1923. T. F.
Erysiphe cichoracearum DC.	Egypt, Sept., 1928. R. M. N.
Oidium abelmoschi Thuem.	Mansura, July, 1876.
Oidium abelmoschi Thuem.	Libyan desert (El Homrah), date ?.
Oidium abelmoschi Thuem.	Near Shubra, date ?.
Oidium sp.	Mit Ghamr, Oct. 21, 1928. L.E.M. et al.
Holcus sorghum Linn.	
Sclerospora graminicola (Sacc.) Schroet. var. andropogonis-sorghi Kulkarni	Giza, July 1, 1928. L.E.M. et al.
Sorosporium reilianum (Kuehn) McAlp.	Fayoum, Nov. 25, 1928. L.E.M. et al.
Sorosporium reilianum (Kuehn) McAlp.	Kena, Assuit, July 5, 1928. L.E.M. et al.
Sphacelotheca sorghi (Link) Clint.	Fayoum, 1927. L. E. M. et al.
Sphacelotheca sorghi (Link) Clint.	Kena, Assuit, 1928. L.E.M. et al.
Hordeum vulgare Linn.	
Cladosporium sp.	Abu Hommos, Jan. 4, 1929. L.E.M. et al.
Erysiphe graminis DC.	Giza farm, Mar. 28, 1928. L.E.M. et al.
Helminthosporium gramineum Rabh.	Egypt, 1920-22. B. J.
Helminthosporium gramineum Rabh.	Egypt, 1923. T. F.
Helminthosporium gramineum Rabh.	Damanhour, Jan. 31, 1928. L.E.M. et al.
Helminthosporium teres Sacc.	Egypt, 1920-22. B. J.
Helminthosporium teres Sacc.	Egypt, 1923. T. F.
Helminthosporium teres Sacc.	Giza, Feb. 10, 1928. L.E.M. et al.
Helminthosporium teres Sacc.	Kaliubieh, Mar. 11, 1928. L.E.M. et al.
Heterosporium sp.	Gebel-el-Asfar, Mar. 17, 1928. L. E. M. et al.

Puccinia anomala Rostr.	Giza, Mar. 27, 1928. L. E. M. et al.
Puccinia glumarum (Schum.) Erikss. & Henn.	Mansura, date ?.
Puccinia glumarum (Schum.) Erikss. & Henn.	Egypt, 1920-22. B. J.
Puccinia glumarum (Schum.) Erikss. & Henn.	Egypt, 1923. T. F.
Puccinia glumarum (Schum.) Erikss. & Henn.	Giza crop, 1927. L.E.M. et al.
Puccinia graminis Pers.	Beni Suef, date ?.
Puccinia graminis Pers.	Egypt, 1920-22. B. J.
Puccinia simplex (Koern.) Erikss. & Henn.	Mansura, 1822-25.
Puccinia simplex (Koern.) Erikss. & Henn.	Damietta, Apr., 1822-25.
Ustilago hordei (Pers.) Kell. & Sw.	Beni Suef, date ?.
Ustilago hordei (Pers.) Kell. & Sw.	Bulak near Cairo, March, 1874.
Ustilago hordei (Pers.) Kell. & Sw.	Egypt, 1920-22. B. J.
Ustilago hordei (Pers.) Kell. & Sw.	Egypt, 1923. T. F.
Ustilago hordei (Pers.) Kell. & Sw.	Gemmaiza farm, 1928. L. E. M. et al.
Ustilago nuda (Jens.) Kell. &. Sw.	Mariout near Alexandria, date ?.
Ustilago nuda (Jens.) Kell. &. Sw.	Assuit, Aug., 1864.
Ustilago nuda (Jens.) Kell. &. Sw.	Quan-el-Gharbi and Esleh ?, Mar. 9, 1864.
Ustilago nuda (Jens.) Kell. &. Sw.	Egypt, 1920-22. B. J.
Ustilago nuda (Jens.) Kell. &. Sw.	Egypt, 1923. T. F.
Ustilago nuda (Jens.) Kell. &. Sw.	Egypt, 1928. L.E.M. et al.
Hyacinthus mauritanicus Th. Dur. & Schinz.	
Ustilago vaillantii Tul.	Mariout district, Mar., 1880.
Ustilago vaillantii Tul. v. tourneuxii Fischer v. Waldh.	Alexandria date ?.
Imperata cylindrica Beauv.	
Puccinia rufipes Diet	Damietta, Apr., 1820-25.
Puccinia rufipes Diet	El-Marg near Cairo, Apr. 27, 1908.
Puccinia rufipes Diet.	Shubra near Cairo, date ?.
Sphacelotheca schweinfurthiana (Thuem.) Sacc.	Kharga Oasis, date ?
Sphacelotheca schweinfurthiana (Thuem.) Sacc.	Small oasis, Libyan desert, El-Hais, date ?.
Sphacelotheca schweinfurthiana (Thuem.) Sacc.	Cairo, 1864.
Sphacelotheca schweinfurthiana (Thuem.) Sacc.	Alexandria, 1876 (?).

Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Damietta, 1876 (?).
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Farafrah Oasis, 1876.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Mansura, 1876 (?).
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Oasis in Dakhla, 1876.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Wadi Tumilat, May, 1880.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Shubra, Cairo, Oct., 1887.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Assuit, Mar. 27, 1893.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Giza, May 4, 1908.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Egypt, 1920-22. B. J.
Sphacelotheca schweinfurthiana (Thuem.) Sacc. ---------------- Giza, Oct. 2, 1928. L. E. M. et al
Vermicularia culmifraga Fr. ----- El-Marg, Apr. 27, 1908.

Juncus acutus Linn.
Puccinia rimosa (Link) Wint. ---- Damietta, Apr., 1822-25.

Juncus maritimus Lam.
Puccinia rimosa (Link) Wint. ---- Between Gaza and El Arish, May 12, 1877.

Juncus subulatus Forsk.
Puccinia rimosa (Link) Wint. ---- El Arish, May 24, 1928, L.E.M. et al.

Juncus sp.
Puccinia rimosa (Link) Wint. ---- Alexandria, Oct., 1822-25.
Puccinia rimosa (Link) Wint. ---- Ramleh, Alexandria, May 29, 1890.
Puccinia rimosa (Link) Wint. ---- Ramleh, Alexandria, Apr. 1, 1892.

Koeleria berythea Boiss. & Blanche
Puccinia longissima Schroet. ------ Egypt, date ?.

Lactuca sativa Linn.
Bremia lactucae E. Regel -------- Wadi Risched, May, 1893.
Bremia lactucae E. Regel -------- Egypt, 1920-22. B. J.
Bremia lactucae E. Regel -------- Egypt, 1923. T. F.
Rhizoctonia spp. ---------------- Egypt, 1920-22. B. J.

Launaea glomerata Hook.
Puccinia launaeae R. Maire ---- Mahadi, near Cairo, date ?.
Puccinia launaeae R. Maire ---- Tura near Cairo, date ?.

Launaea nudicaulis Hook.
Bremia lactucae E. Regel -------- Heluan, May 3, 1893.
Puccinia launaeae R. Maire ------- El-Marg near Cairo, Apr. 27, 1908.

Lecanora cerina (Ehrh.) Ach.
Pharcidia epicymatia (Wallr.) Winter ---------- Ras-el-Kanais, 1901 (?).

Lepturus incurvatus Trin.
Ustilago lepturi (Thuem.) P. Henn. Damietta, Apr., 1876.

Linum usitatissimum Linn.
Cicinnobolus cesatii DeBary In Oidium erysiphoides Fr. ----- Fayoum, April, 1879.
Melampsora lini (Schum.) Desm. - Damietta, Apr., 1876.
Melampsora lini (Schum.) Desm. - Fayoum, Jan., 1877.
Melampsora lini (Schum.) Desm. - Giza, Mar. 14, 1928. L.E.M. et al.
Pleospora herbarum (Pers.) Rabenh. ---------- Island of Cyprus, June, 1928. L. E. M. et al.

Lippia nodiflora Cham.
Oidium lippiae Thuem. ---------- Gesirah near Cairo, date ?.

Lolium perenne Linn.
Erysiphe graminis DC. ---------- Mit Kamo, Apr., 1822-25.
Puccinia coronifera Klebahn= Puccinia coronata Cda. -------- Alexandria, Mar., 1822-25.
Puccinia coronifera Klebahn= Puccinia coronata Cda. -------- Mit Kamo, Apr., 1822-25.

Lolium temulentum Linn.
Puccinia dispersa Erikss. & Henn. Alexandria, May 14, 1894.
Ustilago lolii P. Magnus --------- Mariout Lake, Amria, Apr. 13, 1908.

Lotus arabicus Linn.
Uromyces anthyllidis (Grev.) Schroet. ---------- Alexandria, May 2, 1890.

Lotus glinoides Delile
Uromyces anthyllidis (Grev.) Schroet. ---------- Alexandria, Apr. 17, 1912.

Lotus villosus Forsk.
Uromyces anthyllidis (Grev.) Schroet. ---------- Abukir, Apr. 17, 1912.
Uromyces anthyllidis (Grev.) Schroet. ---------- Damietta, Apr. 17, 1912.

Lupinus digitatus Forsk.
Uromyces renovatus Sydow ------ Fayoum, date ?.

Lycium europaeum Linn.
Puccinia turgida Sydow --------- El Arish, Sinai Penn., May 23, 1928. L. E. M. et al.

Lycium sp.
Pleospora rotundata I. Reichert -- Bir Kres, Sept., 1822 25.

Lycopersicum esculentum Mill.
Alternaria solani (E. & M.) Jones and Grout ---------- Egypt. 1920-22. B. J.

Cladosporium fulvum Cke. ------- Giza, Dec., 1927. L.E.M. et al.
Cladosporium fulvum Cke. ------- Mansura, Oct. 31, 1927. L.E.M. et al.
Macrosporium tomato Cke. ------- Egypt, 1920-22. B. J.

Malcolmia aegyptiaca Spreng.
Albugo candida (Pers.) O. Kunze - Sakkara, May 3, 1908.

Malus sp. (apple)
Bacterium tumefaciens EFS.= Pseudomonas tumefaciens EFS. & Towns. ------------------- Egypt, 1924-25.
Bacterium tumefaciens EFS.= Pseudomonas tumefaciens EFS. & Towns. ------------------- Barrage, Nov. 20, 1928. L.E.M. et al.

Malva sp.
Oidiopsis sp. ------------------- Minia, Nov. 23, 1927. L.E.M. & M. B.

Mangifera indica Linn.
Bacillus mangiferae Doidge (Probably erroneously reported) Egypt, 1920-22. B. J.
Colletotrichum gloeosporioides Penz. Egypt, 1923. T. F.
Diplodia sp. (twigs) ------------- Egypt, 1930. H. S. Fawcett.
Epicoccum sp. (leaves) ---------- Egypt, 1930. H. S. Fawcett.
Oidium mangiferae Berthet. ------ Egypt, 1920-22. B. J.
Oidium sp. --------------------- Egypt, 1930. H. S. Fawcett.

Medicago ciliaris Krock.
Darluca filum (Bivon.) Cast. In uredosori of Uromyces striatus Schroet. Damietta, Dec., 1911.
Uromyces striatus Schroet. ------- Damietta, Apr. 20, 1912.

Medicago denticulata Willd.
Oidium medicagineum Thuem. ---- Fayoum, Mar., 1879.

Medicago sativa Linn.
Pseudopeziza (Phacidium) trifolii (Bernh.) Fckl. v. medicaginis Lib. Giza, Apr., 1899. Fletcher.
Rhizoctonia spp. --------------- Egypt, 1920-22. B. J.
Uromyces medicaginis Pass. ------ Birket-el-Sab, 1880.
Uromyces medicaginis Pass. ------ Abu Korkas, Nov. 23, 1927. L.E.M. et al.
Uromyces medicaginis Pass. ------ Giza, Nov., 1928. L. E. M. et al.
Uromyces striatus Schroet. ------ Birket-el-Sab, date ?.
Uromyces striatus Schroet. ------ Abu Korkas, Nov. 23, 1927. L. E. M. et al.

Melilotus parviflorus Desf.
Oidium erysiphoides Fr. ---------- Ismailia, Apr., 1880.
Oidium erysiphoides Fr. ---------- Rosetta, May 10, 1902.

Melilotus sp.
Peronospora trifoliorum DeBary -- Egypt, 1920-22. B. J.

Mentha sp.

Puccinia menthae Pers. ---------- Desouk, June 5, 1929. S -el -N.

Mistletoe (from England)
Sphaeropsis visci (Westd.) Archer Alexandria Customs Office, June 17, 1929. R.M.N.

Morus alba Linn.
Cercospora snelliana I. Reichert -- Bahtim near Kahiram, Nov., 1913.

Musa sp.
Cercospora (? musarum) Ashby "Black-tip" ------------------ Giza, Dec. 1, 1928. L. E. M. et al.
Cercospora (? musarum) Ashby "Black-tip" ------------------ Alexandria, Jan., 1928. L.E.M. et al.

Nasturtium sp.
Albugo candida (Pers.) O. Kunze - Beni Suef, May 3, 1908.

Noaea mucronata Aschers & Schweinf.
Mycosphaerella engleriana I. Reichert --------------------- Abukir, Oct., 1822-25.

Olea europaea Linn.
Macrosporium oleae I. Reichert --- Near Giza, Kahiram, Sept. 26, 1912.

Opuntia ficus-indica Mill.
Aspergillus candidus Link ------- Bulak, date ?.
Bispora opuntiicola I. Reichert ---- Alexandria, 1822-25.
Cladosporium pyriformum I. Reichert -------------------------- Bulak, 1822-25.
Diplodia opuntiae Sacc. ----------- Bulak, 1822-25.
Torula opuntiae I. Reichert ------ Kahiram, 1822-25.

Oryza sativa Linn
Fusarium roseum Link ---------- Rosetta, date ?.
Helminthosporium oryzae v. Breda de Haan --------------------- Dakahlieh Prov., Nov., 1927. L. E. M. et al.
Helminthosporium oryzae v. Breda de Haan --------------------- Derin, Nabaroh, Talkha, Nov. 3, 1927. L. E. M. et al.
Helminthosporium oryzae v. Breda de Haan --------------------- Damanhour, Nov. 6, 1927. L.E.M. et al.
Helminthosporium oryzae v. Breda de Haan --------------------- Sakha Domains, Oct. 27, 1927. L. E. M. et al.
Helminthosporium oryzae v. Breda de Haan --------------------- Sidi Ghazi, Biela, Merabin, Kafr-el-Shiekh, Talkha, Nov. 4, 1927. L. E. M. et al.
Helminthosporium oryzae v. Breda de Haan --------------------- Kafr-el-Shiekh, Jan. 17, 1929. L. E. M. et al.

Helminthosporium spp. ----------- Fayoum, Nov. 24, 1927. L.E.M. et al.
Helminthosporium spp. ----------- Gharbieh Prov., Nov. 1927. L. E. M. et al.
Helminthosporium spp. ----------- Kafr-el-Teraa, Nov. 1, 1927. L. E. M. et al.
Helminthosporium spp. ----------- Mansura, Oct. 30, 1927. L.E.M. et al.

Pancratium sp.
Torula herbarum Link ----------- Cairo, 1901 (?).

Panicum colonum Linn.
Uredo coloni I. Reichert ---------- Beni Suef, Jan., 1822-25.
Ustilago trichophora (Link) Kze. - Egypt, 1820-24.

Panicum crus-galli Linn.
Brachysporium flexuosum (Cda.) Sacc. ------------------------ Alexandria, Nov. , 1877.

Panicum dichotomum Forsk.
Ustilago penniseti Rabh. --------- Wadi Risched, May 3, 1893.

Panicum repens L.
Uromyces linearis B. & Br. ------ Mansura, date ?.
Ustilago digitariae (Kunze) Rabh. Menzaleh Lake, July 10, 1877.

Panicum sanguinale Linn.
Ustilago digitariae (Kunze) Rabh. Cairo, date ?.

Papaver somniferum Linn.
Peronospora arborescens (Berk.) DeBary ---------------------- Egypt, 1920-22. B. J.

Pennisetum dichotomum Delile
Sphacelotheca ischaemi (Fuck.) Clinton ---------------------- Cairo, May, 1820.
Sphacelotheca penniseti (Rbh.) I. Reichert --------------------- Wadi Hof near Heluan, date ?.
Sphacelotheca penniseti (Rbh.) I. Reichert --------------------- Near Basettin near Cairo, Apr. 11, 1878.
Sphacelotheca penniseti (Rbh.) I. Reichert --------------------- Wadi Chafura, Apr. 20, 1880.
Sphacelotheca penniseti (Rbh.) I. Reichert --------------------- Heluan, May 3, 1883 (?)
Ustilago ischaemi Fuck. --------- Cairo, desert Basettin, May, 1820-24.

Phalaris minor Retz. v. **gracilis** (Parl.
Erysiphe graminis DC. ----------- West Mariout Lake, Apr., 13, 1908.

Phaseolus vulgaris Linn.
Bacterium phaseoli= Pseudomonas phaseoli EFS. --- Egypt, 1923. T. F.
Uromyces appendiculatus (Pers.) Link ------------------------ Egypt, 1920-22. B. J.
Uromyces appendiculatus (Pers.)

Link	Ras-el-Khalig, Nov. 1, 1927. L.E.M. et al.
Uromyces appendiculatus (Pers.) Link	Barrage, Egypt, Nov. 12, 1927. L. E. M. et al.

Phoenix dactylifera Linn.

Aspergillus phoenicis (Cda.) Lindau	Alexandria, 1837.
Aspergillus phoenicis (Cda.) Lindau	Large Oasis, Dec., 1901.
Aspergillus phoenicis (Cda.) Lindau	Cairo, Dec., 1901.
Bispora hamonis (Ehrenb.) I. Reichert	Near Bir Haie, Dec., 1822-25.
Clasterosporium lindavianum I. Reichert	Kahiram, 1822-25.
Coniothecium heterosporum I. Reichert	Bir Haie, Nov., 1822-25.
Diplodia sp.	Egypt, 1930. H. S. Fawcett.
Graphiola phoenicis (Moug.) Poit.[1]	Alexandria, 1822-25.
Graphiola phoenicis (Moug.) Poit.	Alexandria, Feb. 20, 1855.
Graphiola phoenicis (Moug.) Poit.	Damietta, Apr. 21, 1887.
Graphiola phoenicis (Moug.) Poit.	Burg-el-Brallus, Apr. 3, 1887.
Graphiola phoenicis (Moug.) Poit.	Alexandria (Ramleh), May 29, 1890.
Graphiola phoenicis (Moug.) Poit.	Rosetta, May 10, 1902.
Graphiola phoenicis (Moug.) Poit.	Cairo (El Marg), Apr. 27, 1908.
Graphiola phoenicis (Moug.) Poit.	Between El-Mex and Mariout, Apr. 10, 1908.
Graphiola phoenicis (Moug.) Poit.	Alexandria, 1912.
Graphiola phoenicis (Moug.) Poit.	Esna, date ?.
Graphiola phoenicis (Moug.) Poit.	Near Kingi-Mariout, date ?.
Graphiola phoenicis (Moug.) Poit.	Near Abu Hamrah in the Oasis Quatyeh, date ?.
Graphiola phoenicis (Moug.) Poit.	Bahtim near Cairo, date ?.
Graphiola phoenicis (Moug.) Poit.	Egypt, 1920-22. B. J.
Graphiola phoenicis (Moug.) Poit.	Egypt, 1923. T. F.
Graphiola phoenicis (Moug.) Poit.	Egypt, 1924-25.
Graphiola phoenicis (Moug.) Poit.	Common in Lower and Middle Egypt, 1927. L. E. M. et al.
Graphiola phoenicis (Moug.) Poit.	Common in Lower and Middle Egypt, 1928. L. E. M. et al.
Graphiola phoenicis (Moug.) Poit.	Common in Lower and Middle Egypt, 1929. L. E. M. et al.
Phomopsis sp.	Egypt, 1930. H. S. Fawcett.
Phyllosticta palmarum Rabanh.	Esna, date ?.
Ustilago phoenicis Cda.	Cairo, Jan., 1876.

1. It is of interest to note that this fungus is not to be found in the oases of Siwa, Dakhla, Farafrah, Baharia and Kharga, where many date palms occur.

Phragmites communis Trin.	
Bispora hamonis (Ehrenb.) I. Reichert	Bir Haie, Nov., 1822-25.
Melanopsamma pomiformis (Pers.) Sacc.	Damietta, March, 1822-25.
Phragmites communis Trin. v. isiaca (Del.) Cosson	
Clasterosporium lindavianum I. Reichert	Kahiram, 1822-25.
Diplodina donacina (Sacc.) Allescher	Cairo, Feb., 1822-25.
Fomes fomentarius (L.) Fr.	Alexandria, 1910.
Leptosphaeria donacina Sacc.	Egypt, date ?.
Melanconium echinosporum I. Reichert	Egypt, Mar., 1822-25.
Microdiplodia machlaiana I. Reichert	Egypt, date ?.
Puccinia isiacae (Thuem.) Winter	Damietta, March, 1822-25.
Puccinia magnusiana Koern.	Damietta, date ?.
Scirrhia rimosa (Alb. & Schw.) Fuck.	Menzaleh, Mar., 1822-25.
Torula herbarum Link	Mansura, 1822-25.
Pisum sativum Linn.	
Erysiphe polygoni DC.	Manfalut, Jan. 9, 1928. L.E.M. et al.
Rhizoctonia spp.	Egypt, 1920-22, B. J.
Plantago lagopus Linn.	
Erysiphe cichoracearum DC.	Kafr Namran near Niltala by Pelusia, May, 1880.
Polygonum bellardi All.	
Uromyces polygoni (Pers.) Fuck.	Near Tell-el-Kebir in Wadi Tumilat, May 1880.
Uromyces polygoni (Pers.) Fuck.	El-Marg near Cairo, Apr. 28, 1908.
Polypogon monspeliensis Desf.	
Entyloma schweinfurthii P. Henn.	Giza pyramids, Mar., 1902.
Erysiphe graminis DC.	San, Mar., 1822-25.
Puccinia coronifera Klebahn= Puccinia coronata Cda.	Damietta, Apr. 18, 1912
Puccinia coronifera Klebahn= Puccinia coronata Cda.	Alexandria near Gabbari, Apr. 26, 1874.
Populus spp.	
Armillaria mellea Vahl.	Egypt, 1920-22. B. J.
Polyporus hispidus (Bull.) Fr.	Egypt, 1920-22. B. J.
Portulaca oleracea Linn.	
Cystopus portulacae (DC.) Lev.	Egypt, 1920-22. B. J.

Cystopus portulacae (DC.) Lev. ----	Mansura, Oct. 31, 1927. L.E.M. et al.
Prunus armeniaca Linn.	
Coryneum sp. (beijerinckii?) ------	Cairo, 1929.[1]
Puccinia pruni-spinosae Pers. ----	Cairo, Nov., 1913.
Sphaerotheca pannosa (Wallr.) Lev.	Egypt, 1923. T. F.
Tranzschelia punctata (Pers.) Arth. =Puccinia pruni-spinosae Pers. -	Korashia Province, Oct. 30, 1928. L. E. M. et al.
Prunus persica Stokes	
Exoascus deformans (Berk.) Fuck.	Menzaleh, 1887 (?).
Puccinia pruni-spinosae Pers. ----	Cairo, Feb. 10, 1180. (?).[2]
Prunus sp.	
Bacterium tumefaciens EFS.= Pseudomonas tumefaciens EFS. & Towns. -------------------	Egypt, 1924-25.
Podosphaera oxyacanthae (Fr.) De Bary ----------------------	Egypt, 1920-22. B. J.
Tranzschelia punctata (Pers.) Arth. =Puccinia pruni-spinosae Pers. -	Burg-el-Arab, Oct. 18, 1928. L. E. M. et al.
Tranzschelia punctata (Pers.) Arth. =Puccinia pruni-spinosae Pers. -	Ragdia, Nov. 13, 1927. L.E.M. et al.
Quercus sp.	
Stereum hirsutum (Willd.) Fr. ----	Cairo, Dec. 23, 1902.
Raphanus sativus Linn.	
Rhizoctonia spp. ---------------	Egypt, 1920-22. B. J.
Reaumuria mucronata Faub. & Spach.	
Uredo reaumuriicola P. Henn. ----	Heluan, Mar., 1899.
Uredo reaumuriicola P. Henn. ----	Wadi Ghisi south Galala, date ?.
Reichardia picroides Roth.	
Albugo tragopogonis (DC.) S. F. Gray -----------------------	Alexandria, date ?.
Reseda pruinosa Delile	
Albugo candida (Pers.) O. Kunze	Alexandria, date ?.
Ricinus communis Linn.	
Melampsora ricini Pass. ---------	Suez, date ?.
Melampsora ricini Pass. ---------	Egypt, 1920-22. B. J.
Melampsora ricini Pass. ---------	Giza, Mar. 17, 1928. L.E.M. et al.
Rhizoctonia spp. ---------------	Egypt, 1920-22. B. J.
Rosa centifolia Linn.	
Oidium leucoconium Desm. -------	Cairo, Dec., 1875.

1. Found on fruit shipped into Egypt.

2. I. Reichert in Die Pilzflora Aegyptens records this year. It is unquestionably an error.

Phragmidium disciflorum (Tode) James ---------- Cairo, Dec., 1875.

Rosa gallica Linn.
Cercospora rosicola Passer. ------- Cairo, date ?.
Cercospora rosicola Passer. ------- West Cairo, date ?.

Rosa spp.
Actinonema rosae (Lib.) Fr. See Diplocarpon rosae (Lib.) Wolf. - Egypt, 1920-22. B. J.
Actinonema rosae (Lib.) Fr. See Diplocarpon rosae (Lib.) Wolf. - Meadi, May 10, 1928. M. B.
Diplocarpon rosae (Lib.) Wolf. ---- Gharbieh, 1927. L. E. M. et al.
Diplocarpon rosae (Lib.) Wolf. ---- Meadi, May 10, 1928. M. B.
Oidium leucoconium Desm. ------- Kafr-Demuhra near Zagazig, Dec. 8, 1901.
Peronospora sparsa Berk. -------- Egypt, 1924-25.
Phragmidium subcorticium (Schrank.) Wint. ---------- Egypt, 1920-22. B. J.
Phragmidium subcorticium (Schrank.) Wint. ---------- Egypt, 1923. T. F.
Phragmidium subcorticium (Schrank.) Wint. ---------- Mansura, Nov. 4, 1927. L.E.M. et al.
Sphaerotheca pannosa (Wallr.) Lev. Egypt, 1920-22. B. J

Rottboellia compressa Linn.
Puccinia rottboelliae Sydow ------ Nile Delta, Dec., 1911.

Rottboellia compressa Linn. v. fasciculata Hack.
Darluca filum (Bivon.) Cast.
In uredosori of Puccinia rottboelliae Sydow ---------- Farasun Delta, Dec., 1911.

Rubus sp.
Phragmidium violaceum (Schultz.) Wint.[1] ---------- Mehalet-el-Kasab, Dec. 4, 1927. L. E. M. et al.

Rumex dentatus Linn.
Uromyces rumicis (Schum.) Wint. Near Gassatin in Wadi Tumilat, May, 1880.

Saccharum biflorum Forsk.
Hormiscium saccharicolum I. Reichert ----------

Saccharum officinarum Linn. Girga and Akhmim, Jan., 1822-25.
Aspergillus flavus Link ---------- Egypt, 1923. T. F.[2]
(Erroneous report)

1. First time reported on host. Determined by W. W. Diehl and R. W. Davidson.

2. In leaflet by Egyptian Ministry of Agriculture. List of Fungous, Bacterial and Physiologic Diseases, 1923, by T. Fahmy. This organism is reported as the cause of mosaic.

Salicornia fruticosa Linn.
Bispora hamonis (Ehrenb.) I. Reichert ---------- Cairo, Mar., 1822-25.

Salix tetrasperma Roxb.
Marssonina kriegeriana (Bres.) P. Magnus ---------- Delta region, 1930. R. M. N.

Salix sp.
Cercospora sp. ---------- El Hawaber, Oct. 15, 1928. L. E. M. et al.
Gloeosporium salicis West. ---------- Giza, June 20, 1928. L. E. M. et al.
Marssonina kreigeriana (Bres.) P. Magnus ---------- Alexandria, date ?.
Melampsora (salicis-albae Kleb.)? Giza, Mar. 10, 1928. S.-el-D.

Salsola longifolia Forsk.
Glonium salsolae I. Reichert ---------- Abukir, Oct., 1822-25.
Mycosphaerella engleriana I. Reichert ---------- Abukir, Oct., 1822-25.

Salsola sp.
Pleospora lindaviana I. Reichert -- Kasr Eschtrach, Nov., 1822-25.

Schanginia baccata Moq.
Uromyces schanginiae Thuem. ---- Damietta, July, 1876.

Schanginia hortensis Moq.
Uromyces schanginiae Thuem. ---- Fort Sulkowski near Cairo, May, 1880.

Schismus calycinus Coss.
Ustilago aegyptiaca Fischer v. Waldh. ---------- Cairo, 1822-25.
Ustilago aegyptiaca Fischer v. Waldh. ---------- Quatyeh, Apr. 29, 1887.
Ustilago aegyptiaca Fischer v. Waldh. ---------- Mokkattam, Cairo, May 7, 1908.

Scirpus maritimus Linn.
Uromyces scirpi (Cast.) Burr. ---- Damietta, date ?.

Scirpus sp.
Puccinia scirpi DC. ---------- Mallaha, date ?.
Puccinia scirpi DC. ---------- Damietta, Mar., 1822-25.

Scleropoa memphitica Boiss.
Ustilago aschersoniana Fischer v. Waldh. ---------- In the little oases, Quacr-Bauiti, Libyan Desert, April, 1886.
Ustilago aschersoniana Fischer v. Waldh. ---------- Qugah, Apr. 29, 1887.
Ustilago aschersoniana Fischer v. Waldh. ---------- Near pyramids Giza, May 3, 1908.
Ustilago aschersoniana Fischer v. Waldh. ---------- Rosetta, date ?.

Sesamum sp.
Rhizoctonia spp. ---------------- Egypt, 1920-22. B. J.
Setaria viridis Beauv.
Uromyces setariae-italicae (Diet.) Yosh. ------------------------ Mariout Distr., Oct. 15, 1928. L. E. M. et al.
Sisymbrium irio Linn.
Albugo candida (Pers.) O. Kunze Damietta, May 2, 1908.
Solanum lycopersicum Linn.
Phytophthora infestans (Mont.) De Bary ------------------------ Fayoum, Jan., 1877.
Solanum melongena Linn.
Erysiphe taurica Lev. ------------ Manfalut, 1923. T. F.
Oidiopsis taurica (Lev.) Salm. ---- Egypt, 1920-22. B. J.
Oidiopsis taurica (Lev.) Salm. ---- Egypt, 1923. T. F.
Oidiopsis taurica (Lev.) Salm. ---- Mansura, Nov. 4, 1927. L.E.M. et al.
Oidiopsis taurica (Lev.) Salm. ---- Alexandria, Nov. 12, 1927. L.E.M. et al.
Oidiopsis taurica (Lev.) Salm. ---- Tanta, Nov. 12, 1927. L. E. M. et al.
Solanum tuberosum Linn.
Bacillus solanacearum EFS. ------ Egypt, 1920-22. B. J.
(Probably erroneously reported)
Fusarium spp. ------------------ Alexandria, Mar., 1928. L.E.M. et al.
Fusarium spp. ------------------ Barrage, Feb., 1928. L.E.M. et al.
Macrosporium solani Ell. & Mart. Egypt, 1923. T. F.
(Erroneously reported as leaf curl)
Spinacia oleracea Linn.
Peronospora effusa (Grev.) Rabh. - Egypt, 1920-22. B. J.
Peronospora effusa (Grev.) Rabh. - Cairo, Feb., 1927. L.E.M. and M. B.
Sporobolus spicatus Kunth
Coniothyrium sporoboli I. Reichert In desert at Heluan, Dec., 1905.
Sphaerodothis schweinfurthii I. Reichert --------------------- Rosetta, 1822-25.
Suaeda vera Forsk.
Uromyces chenopodii (Duby) Schr. Near Salehieh in Wadi Tumilat, May, 1880.
Tamarix articulata Vahl.
Polyporus hispidus (Bull.) Fr. ---- Alexandria, Dec., 1908.
Tamarix mannifera Ehrenb.
Coniothecium tamariscinum Thuem. Wadi Giaffara near Bilbeis, June, 1880.
Tamarix sp.
Tryblidium punctum Pat. -------- El Arish, date ?.
Thymelacea hirsuta Endl.
Coniothecium heterosporum I. Reichert --------------------- Bir Hamam, Dec., 1822-25.
Tricholaena teneriffa Parl.
Ustilago tricholaenae P. Henn. ---Wadi Chafura, Mar., 1880.

Trifolium alexandrinum Linn.	
Erysiphe polygoni DC.	Manfalut, 1920-22. B. J.
Erysiphe polygoni DC.	Egypt, 1924-25.
Oidium erysiphoides Fr.	Minich, Apr., 1893.
Trifolium resupinatum Linn.	
Phyllachora trifolii (Pers.) Fuck.	El Marg, Cairo, Apr. 27, 1919
Polythrincium trifolii Kunze	Mansura, Apr., 1822-25.
Trigonella foenum-graecum Linn.	
Oidium erysiphoides Fr.	Fayoum, Mar., 1879.
Uromyces anthyllidis (Grev.) Schroet.	Near Abuksa near Fayoum, Apr., 1879.
Uromyces anthyllidis (Grev.) Schroet.	Alexandria, date ?.
Trigonella hamosa Linn.	
Oidium erysiphoides Fr.	Assuit, Mar., 1893.
Trigonella laciniata Linn.	
Oidium erysiphoides Fr.	Assuit, Mar., 1893.
Trigonella occulta Delile	
Uromyces anthyllidis (Grev.) Schroet.	Quatyeh Sta., Apr. 23, 1902.
Trigonella stellata Forsk.	
Oidium erysiphoides Fr.	In desert of Wadi Aschar, Mar., 1877.
Triticum durum Desf.	
Puccinia triticina Erikss.	Giza, Apr. 21, 1908.
Tilletia tritici (Bjerk.) Wint.	Zagazig, May 14, 1888.
Ustilago tritici (Pers.) Jens.	Assuit, Mar. 10, 1893.
Triticum spelta Linn.	
Ustilago tritici (Pers.) Jens.	Zagazig, May 15, 1888.
Triticum vulgare Vill.	
Puccinia triticina Erikss.	Beni-Suef, date ?.
Ustilago tritici (Pers.) Jens.	Damietta, date ?.
Ustilago tritici (Pers.) Jens.	Kharga Oases, Mar., 1874.
Ustilago tritici (Pers.) Jens.	Assuit, Mar. 10, 1893.
Triticum vulgare Vill. f. **coerulescens**	
Puccinia triticina Erikss.	Assuit, 1893.
Triticum sp.	
Cladosporium herbarum (Pers.) Link	Lower Egypt, 1920-22. B. J.
Pseudomonas tritici Hutchinson	Egypt, 1920-22. B. J.
Pseudomonas tritici Hutchinson	Gemmaiza, Mar. 15, 1928.[1] L.E.M. et al.
Puccinia glumarum (Schum.) Erikss. & Henn.	Egypt, 1920-22. B. J.

1. The author merely reports the occurrence and collection and has not determined the organism, although literature from Egypt states P. tritici as the organism. It is associated with Tylenchus tritici infected ears.

Puccinia glumarum (Schum.) Erikss. & Henn.	Egypt, 1923. T. F.
Puccinia glumarum (Schum.) Erikss. & Henn.	Giza, Mar. 24, 1928. L.E.M. et al.
Puccinia glumarum (Schum.) Erikss. & Henn.	Distamia, May 4, 1928. L.E.M. et al.
Puccinia glumarum (Schum.) Erikss. & Henn.	Barrage, Apr. 21, 1928. L.E.M. et al.
Puccinia glumarum (Schum.) Erikss. & Henn.	Nag Hamadi, Feb. 26, 1928. L.E.M. et al.
Puccinia glumarum (Schum.) Erikss. & Henn.	Zahweir, Shebin, Mar. 17, 1928. L. E. M. et al.
Puccinia graminis Pers.	Egypt, 1920-22. B. J.
Puccinia graminis Pers.	Egypt, 1923. T. F.
Puccinia graminis Pers.	Giza, Mar. 19, 1928. L.E.M. et al.
Puccinia triticina Erikss.	Egypt, 1920-22. B. J.
Puccinia triticina Erikss.	Egypt, 1923. T. F.
Puccinia triticina Erikss.	Giza, Jan. 19, 1928. L. E. M. et al. (Earliest record of its occurrence.)
Puccinia triticina Erikss.	Abu Amowri, Feb. 22, 1928. L. E. M. et al.
Puccinia triticina Erikss.	Benha, Mar. 7, 1928. L. E. M. et al
Puccinia triticina Erikss.	Sahali, Mar. 14, 1928. L. E. M. et al.
Puccinia triticina Erikss.	Mit Bera, Mar. 28, 1928. L.E.M. et al
Puccinia triticina Erikss.	Diguoi, Mar. 30, 1928. L.E.M. et al.
Puccinia triticina Erikss.	Tahabush, Apr. 10, 1928. L.E.M. et al.
Puccinia triticina Erikss.	Mushtohor, Apr. 11, 1928. L.E.M. et al.
Puccinia triticina Erikss.	Kaliub, Apr. 14, 1928. L.E.M. et al.
Puccinia triticina Erikss.	Kafr.-el-Shiekh, Apr. 14, 1928. L. E. M. et al.
Rhizoctonia spp.	Dakahlieh Prov., Dec., 1927. L. E. M. et al.
Tilletia levis Kuehn.	Egypt, 1920-22. B. J.
Urocystis tritici Koern.	Egypt, 1923. T. F.
Urocystis tritici Koern.	Egypt, 1927. L. E. M. et al.
Urocystis tritici Koern.	Mansura, Jan. 3, 1928. L.E.M. et al.
Urocystis tritici Koern.	Kallin, Feb., 1928. L. E. M. et al.
Urocystis tritici Koern.	Menoufieh, Feb. 10, 1928. L.E.M. et al.
Urocystis tritici Koern.	Telwana, Feb. 14, 1928. L.E.M. et al.
Ustilago tritici (Pers.) Jens.	Egypt, 1920-22. B. J.
Ustilago tritici (Pers.) Jens.	Egypt, 1923. T. F.
Ustilago tritici (Pers.) Jens.	Egypt in general, Feb., 1928.[1] L. E. M. et al.

1. Occurs in practically every wheat field. From trace to 12 per cent infection.

Ustilago tritici (Pers.) Jens. ----- Egypt in general, Feb., 1929. L. E. M. et al.

Typha angustifolia Linn.
Cladosporium typharum Desm. ---- Gabbaris near Alexandria, date ?.

Typha latifolia Linn.
Cladosporium typharum Desm. ---- Wadi-el-Natrun, date ?.

Urginea maritima Baker
Uromyces scillarum (Grev.) Wint. - Egyptian-Syrian desert, Mar. 23, 1880.

Varthemia candicans Boiss.
Pleospora rotundata I. Reichert -- Alexandria, 1822-25.

Verbena sp.
Corticium sp. ------------------- Egypt, 1923. T. F.

Vicia calcarata Desf.
Cincinnobolus cesatii De Bary
In Oidium ------------------- Fayoum, Mar., 1899.
Oidium erysiphoides Fr. ---------- Fayoum, Apr., 1879.

Vicia faba Linn.
Peronospora viciae DeBary ------- Egypt, 1923. T. F.
Uromyces fabae (Pers.) DeBary - Cairo, date ?.
Uromyces fabae (Pers.) DeBary - Egypt, 1920-22. B. J.
Uromyces fabae (Pers.) DeBary - Egypt, 1923. T. F.
Uromyces fabae (Pers.) DeBary - Egypt, Aug., 1928. L. E. M. et al.

Vicia lens Coss. & Germ.
Fusarium spp. ------------------ Central Egypt, 1927. L.E.M. et al.
Fusarium spp. ------------------ Esna & Luxor, Central Egypt, 1928. L. E. M. et al.

Vicia sativa Linn.
Uromyces fabae (Pers.) DeBary - Damietta, Apr. 20, 1912.

Vigna sinensis Endl.
Uromyces appendiculatus (Pers.)
Link (Erroneous report) ------- Egypt, 1920-22. B. J.
Uromyces vignae A. Barclay ----- Egypt, 1924-25.
Uromyces vignae A. Barclay ----- Ras-el-Khalig, Nov. 1, 1927. L. E. M. et al.
Uromyces vignae A. Barclay ----- Barrage, Dec., 1928. L.E.M. et al.

Viola odorata Linn.
Cercospora violae Sacc. ---------- Delta Barrage, date ?.

Viola sp.
Cercospora violae Sacc. ---------- Egypt, 1923. T. F.

Vitis vinifera Linn.
Cercospora roesleri (Cattan.) Sacc. Alexandria (Ramleh), Nov. 22, 1911.
Cercospora viticola (Ces.) Sass. -- Egypt, 1920-22. B. J.
Plasmopara viticola (B. & C.) Berl.
& DeToni ------------------- Egypt, 1920-22. B. J.

Plasmopara viticola (B. & C.) Berl. & De Toni	Egypt, 1923. T. F.
Vitis sp.	
Botrytis sp.	Assuit, July 9, 1928. M. B.
Botrytis sp.	Abu-el-Shekuk, July 9, 1928. M. B.
Plasmopara viticola (B. & C.) Berl. & De Toni	Barrage, Aug. 10, 1927. L.E.M. et al.
Plasmopara viticola (B. & C.) Berl. & De Toni	Zifta, July 9, 1928. L. E. M. et al.
Uncinula necator (Schw.) Burr.	Shubra-el-Namla, Nov. 13, 1927. L. E. M. et al.
Uncinula necator (Schw.) Burr.	Ezbet Khorshid, Aug. 26, 1929. S -el D.
Zea mays Linn.	
Helminthosporium turcicum Pass.	Egypt, 1920-22. B. J.
Helminthosporium turcicum Pass.	Egypt, 1923. T. F.
Puccinia maydis Bereng.	Egypt, 1920-22. B. J.
Puccinia maydis Bereng.	Egypt, 1923. T. F.
Puccinia maydis Bereng.	Giza, Oct. 8, 1928. L. E. M. et al.
Puccinia sorghi Schw.	Giza, Oct. 8, 1928. L.E.M. et al.
Sclerospora graminicola (Sacc.) Schroet. var. andropogonis-sorghi Kulkarni	Giza, July 13, 1928. S -el -D.
Ustilago zeae (Beckm.) Ung.	Egypt, 1924-25. S -el -D.
Zilla spinosa Th. Dur. & Schinz.	
Cladosporium herbarum (Pers.) Link	Wadi Dugla near Cairo, 1901 (?).
Zygophyllum decumbens Delile	
Uredo zygophylli P. Henn.	Egypt, May, 1922-25.

PLANT DISEASES OTHER THAN FUNGOUS OR BACTERIAL

Asphyxiation

On Gossypium sp. (cotton)	
Wilt, physiological	Egypt, 1920-22. B. J.
Wilt, physiological	Egypt, 1923. T. F.

Broom Rape

Orobanche crenata Forsk.	
On Vicia faba Linn. Widely distributed.	Egypt, Feb., 1927. L. E. M. et al.
On Vicia faba Linn. Widely distributed.	Egypt, Mar., 1928. L. E. M. et al.
On Vicia faba Linn. Widely distributed.	Egypt, Mar., 1929. L. E. M. et al.
Orobanche ramosa Linn.	
Lycopersicum esculentum Mill.	Cairo, 1835 (?).
Lycopersicum esculentum Mill.	Lower Egypt, Mar., 1927. L.E.M. et al.
Orabanche schweinfurthii Beck.	
Lycopersicum esculentum Mill.	Lower Egypt, Mar., 1927. L.E.M. et al.
Orobanche sp.	
On Solanum tuberosum Linn.	Lower Egypt, Feb., 1928. L.E.M.

Bunchy-Top (Rosetta) of Banana[1]

On Musa sp. Occurs widely spread.	Gharbieh, Dec., 1927. L.E.M. & M. B,
On Musa sp. Occurs widely spread.	Mallawi, Sept., 1928. R.M.N.
On Musa sp. Occurs widely spread.	Tanta, Oct. 8, 1928. A. S -el N.

Chlorosis

On Citrus sp.	Tanta, Nov. 13, 1927. L.E.M. et al.
On Ficus carica Linn.[2]	Alexandria, 1927. L.E.M. et al.
On Ficus carica Linn.	Sharkia, Nov. 13, 1927. L.E.M. et al.
On Ficus carica Linn.	Fayoum, Nov. 24, 1927. L.E.M. et al.
On Ficus carica Linn.	Barrage, 1928. L. E. M. et al.
On Malva sp.	Ragdia, Nov. 13, 1927. L.E.M. et al.

Chocolate Spot

On Citrus spp.	Egypt, Nov. & Dec., 1927. L.E.M.

Die Back (Bacterial ?) (undetermined)

On Vicia faba Linn.	Giza, 1927. L. E. M. et al.
On Vicia faba Linn.	Egypt, 1928. L. E. M. et al.

1. This disease in Egypt seems to be the same as the one described for Australia by C. J. Magee.
2. This may be a mosaic; the cause has not been determined.

Die Back (undetermined)

On Citrus spp. .... Egypt, 1927. L. E. M.
On Citrus spp. .... Egypt, 1928. L.E.M.

Dodder

Cuscuta sp.
On Trifolium alexandrinum Linn. . Beni-Suef, Feb. 11, 1928. L.E.M. el al.
(Widespread in Egypt.)

Exanthema

On Citrus sp. .... Egypt, 1923. T. F.
On Citrus sp. .... Fayoum, Nov. 26, 1927. L.E.M. et al.

Gumming Disease

On Citrus spp. (Leaves.) .... Egypt, Nov. & Dec., 1927. L.E.M.
On Citrus spp. (Leaves.) .... Egypt, Nov. & Dec., 1928. L. E. M.

Gummosis (undetermined)

On Amygdalus persica Linn. .... Egypt, 1920-22. B. J.
On Amygdalus persica Linn. .... Beni-Suef, Nov. 18, 1928. R.M.N.
On Citrus sp. .... Egypt, 1920-22. B. J.
On Citrus sp. (widely distributed) ... Egypt, 1927. M. B.
On Citrus sp. (widely distributed) ... Egypt, 1928. M. B.
On Citrus sp. (widely distributed) ... Egypt, 1929. M. B.
On Prunus armeniaca Linn. .... Egypt, 1923. T. F.
On Prunus sp. (plum) .... Ahmed Royob Dakrosy, Jan. 24, 1928. L. E. M. et al.
On Prunus sp. (plum) .... Hort. Sec., Barrage, May 3, 1928. R. M. N.
On Prunus sp. (plum) .... El Ayat (Bahert) Dec. 10, 1929, M.R.

Leaf-spot (nonparasitic ?)

On Mangifera indica Linn. .... Egypt, 1927. L. E. M. et al.
(Wherever grown)
On Mangifera indica Linn. .... Egypt, 1928. L. E. M. et al.
(Wherever grown)
On Mangifera indica Linn. .... Egypt, 1929. L. E. M. et al.
(Wherever grown)

Lily Disease (Virus)

On Lilium harrisii Carr. .... Giza, Jan., 1928. L. E. M. & M. B.

Mosaic

On Capsicum sp. .... Giza, 1927. L. E. M. et al.
On Capsicum sp. .... Shubra-el-Namla, Nov. 13, 1927. L. E. M. et al.
On Capsicum sp. .... Beni-Suef, Nov. 26, 1927. L.E.M. et al.
On Capsicum sp. .... Amria, Oct. 18, 1928. L. E. M. et al.
On Cucurbita sp. .... Abu-Ksa, Nov. 25, 1927. L.E.M. et al.

On Hordeum vulgare Linn.	Gemmaiza, Jan., 1927. L.E.M.
On Hordeum vulgare Linn.	Giza, Feb., 1927. L. E. M.
On Lactuca sativa Linn.	Alexandria, Feb., 1928. L.E.M. et al.
On Lilium harrisii Car.	Alexandria, Feb., 1927. L.E.M. & M.B.
On Lilium harrisii Car.	Giza, Jan., 1928. L.E.M. & M.B.
On Lycopersicum esculentum Mill.	Shubra-el-Namla, Nov. 13, 1927. L. E. M. et al.
On Lycopersicum esculentum Mill.	Fayoum, Nov. 24, 1927. L.E.M. et al.
On Lycopersicum esculentum Mill.	Beni-Suef, Nov. 26, 1927. L.E.M. et al.
On Phaseolus vulgaris Linn.	Mansura, Oct. 31, 1927. L.E.M. et al.
On Saccharum officinarum Linn.	Egypt, 1920-22. B. J.[1]
On Saccharum officinarum Linn.	Egypt, 1923. T. F.[1]
On Saccharum officinarum Linn.	Abu Korkas, Nov. 21, 1927. L. E. M. et al.
On Saccharum officinarum Linn.	Minia, Nov. 22, 1927. L. E. M. et al.
On Spinacia oleracea Linn.	Alexandria, 1927. L. E. M. et al.
On Spinacia oleracea Linn.	Cairo, 1927. L. E. M. et al.
On Triticum vulgare Vill.	Kaliubieh Prov., Dec. 21, 1927. L. E. M. et al.
On Triticum vulgare Vill.	Giza, Dec. 25, 1927. L. E. M. et al.
On Triticum vulgare Vill.	Kaliubieh, Jan. 10, 1928. L.E.M. et al.
On Triticum vulgare Vill.	Farukia, Feb. 2, 1928. L. E. M. et al.
On Triticum vulgare Vill.	Sharkieh, Feb. 14, 1928. L.E.M. et al.
On Triticum vulgare Vill.	Behera Prov., Feb. 18, 1928. L. E. M. et al.
On Triticum vulgare Vill.	Girga Prov., May 4, 1928. L.E.M. et al.
On Triticum vulgare Vill.	Mustohor, Dec. 24, 1928. L.E.M. et al.
On Triticum vulgare Vill.	Menofia, Dec. 31, 1928. L. E. M. et al.
On Triticum vulgare Vill.	Gemmaiza farm, Jan. 4, 1929. L. E. M. et al.
On Triticum vulgare Vill.	Beni-Suef, Jan. 8, 1929. L. E. M. et al.
On Triticum vulgare Vill.	Heluan, Jan. 17, 1929. L.E.M. et al.
On Triticum vulgare Vill.	Shebin-el-Kom, Jan. 17, 1929. L. E. M. et al.
On Triticum vulgare Vill.	Menofia Prov., Feb. 11, 1929. L. E. M. et al.
On Triticum vulgare Vill.	Giza farm, Dec., 20, 1929. L.E.M. et al.
On Vicia faba Linn.	Giza farm, 1927. L.E.M. et al.
On Vicia faba Linn.	Giza farm, 1928. L. E. M. et al.
On Vigna sinensis Endl.	Gemmaiza, 1927. L. E. M. et al.
On Vigna sinensis Endl.	Barrage, 1928. L. E. M. et al.

Nematode Bacterial Disease of Wheat

Tylenchus tritici (Stein.) Bast. ? and
Pseudomonas tritici Hutch. ?

On Triticum spp. on heads (ears)	Seberbai, Feb. 13, 1928. L.E.M. et al.

1. It is doubtful if these reports are correct. This disease has been confused with streak.

On Triticum spp. on heads (ears) - Khorbeta, Feb. 18, 1928. L.E.M. et al.
On Triticum spp. on heads (ears) - Egypt, 1920-22. B. J.
On Triticum spp. on heads (ears) - Egypt, 1923. T. F.
On Triticum spp. on heads (ears) Guiziret-Abu-Namla, Apr. 7, 1923. L. E M. et al.

Nematode or Eel-worm spp.

On Amygdalus communis Linn. ----- Giza, Feb. 1, 1928. M. B.
On Amygdalus persica Linn. ------- Assuit, 1928. M. B.
On Amygdalus persica Linn. ------- Fayoum, Jan. 30, 1928. M. B.
On Amygdalus persica Linn. ------- Giza, Feb. 1, 1928. M. B.
On Amygdalus persica Linn. ------- Gharbieh, Feb. 2, 1928. M. B.
On Lycopersicum esculentum Mill. -- El Arish, 1927. L. E. M. et al.
On Lycopersicum esculentum Mill. - Egypt, Nov. 27, 1928. R. M. N.
On Musa sp. --------------------- Alexandria, 1901. Axel Preyer.
On Musa sp. --------------------- Alexandria, 1927. L. E. M. et al.
On Musa sp. --------------------- Nina'eh, Jan. 1, 1928. M. B.
On Musa sp. --------------------- Kalubia, Feb. 11, 1928. M. B.
On Musa sp. --------------------- Korashia, Oct. 30, 1928. R. M. N.
On Prunus armeniaca Linn. --------- Giza, Feb. 1, 1928. M. B.
On Solanum melongena Linn. ------- Giza, Sept. 1, 1928. R. M. N.
On Solanum tuberosum Linn. ------- Barrage, Jan., 1928. L. E. M. et al.
On Vicia faba Linn. --------------- El Arish, 1928. L. E. M. et al.
On Vigna sinensis Endl. ----------- Minofia Prov., July 5, 1928. M. B.

Heterodera radicicola (Greef) Muell.

On Musa sp. ------------------- Alexandria, 1902. Looss & Faaden.
On Musa sp. ------------------- Egypt, 1903. Mosseri.

Heterodera sp.

On Musa sp. ------------------- Egypt, 1924. T. F.[1]

Physiological Wilt

On Gossypium sp. (cotton) --------- Egypt, 1920-22. B. J.

Rosette

On Hordeum vulgare Linn.[2] --------- Giza, Jan., 1927. L. E. M. et al.
Occurs widely spread.
On Triticum aestivum Linn.[2] ------- Kaliubieh, Jan. 1, 1928. L. E. M. et al.
On Triticum aestivum Linn. -------- Beni-Suef, Jan. 16, 1928. L.E.M. et al.
On Triticum aestivum Linn. -------- Menofia Prov., Jan. 22, 1928. L. E. M. et al.
On Triticum aestivum Linn. -------- Mallawi, Apr. 23, 1928. L. E. M. et al.
On Triticum aestivum Linn. -------- Giza, Jan. 8, 1929. L.E.M. et al.

Streak Disease

On Saccharum officinarum Linn.[3] --- Kena, Assouan, 1927. L. E. M. et al.

1. This report has been confused with the rosette or bunchy-top disease of banana in publications from Egypt.

2. First time reported; not in publictions of Egypt.

3. Streak occurs wherever sugar cane is grown in Egypt. It is much more common than mosaic and has been confused with the latter disease in reports from Egypt.

On Saccharum officinarum Linn. ----Bedin, Oct. 31, 1927. L. E. M. et al.
On Saccharum officinarum Linn. ----Mansura, Oct. 31, 1927. L. E. M. et al.
On Saccharum officinarum Linn. ----Abu Korka, Nov. 22, 1927. L. E. M. et al.
On Saccharum officinarum Linn. ----Minia, Nov. 22, 1927. L.E.M. et al.
On Saccharum officinarum Linn. ----Giza, Nov., 1927. L. E. M. et al.
On Saccharum officinarum Linn. ----Fayoum, Nov. 24, 1927. L.E.M. et al.
On Saccharum officinarum Linn. ----Ibshavai, Nov. 25, 1927. L.E.M. et al.
On Saccharum officinarum Linn. ----Beni-Suef, Nov. 26, 1927. L.E.M. et al.
On Saccharum officinarum Linn. ----Assuit, Dec., 1927. L. E. M. et al.
On Zea mays Linn. ----------------Giza, July 7, 1928. L.E.M. et al.

Sunburn

On Citrus sp. (fruit) ------------- Egypt, 1928. M. B.

ERRATA

Page	Reads	Should Read
42 (last line)	Antho	Anthony
45	Actinonema rosea	Actinonema rosae
47	Battarea	Battarrea
49	Cladisporium	Cladosporium
51	D'plodia	Diplodina
52	Excascus	Exoascus
52 (line 39)	cessati	cesati
53	Gloesporium	Gloeosporium
53 (line 26)	glucophyllum	glaucophyllum
56 (lines 29 and 30)	Kers.	Pers.
63 (line 25)	Kelbahn	Klebahn
69 (line 41)	herbarium	herbarum
70 (line 11)	armenica	armeniaca
70	Trichloma	Tricholoma
70 (line 27)	nectator	necator
72 (line 13)	B. and Bp.	B. and Br.
72 (line 38)	setaria-italicae	setariae-italicae
73 (line 35)	F. de Welsh.	F. de Waldh.
78	Astragulus	Astragalus
78 (line 29)	vulgarus	vulgaris
78 (line 33)	bromivera	bromivora
84 (line 2)	ficiola	ficicola
86 (line 27)	maunitanicus	mauritanicus
87		Koeleria
96 (line 10)	kreigeriana	kriegeriana
97	Thymelacea	Thymelaea
100 (line 39)	Sass.	Sacc.
102	Orabanche	Orobanche
102 (line 20)	Rosetta	Rosette

THE SWEET POTATO, STEM OR ROOT?

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In an article by Z. Kamerling (1914), he tries to establish the fact that the sweet potato is a tuberous stem and not a tuberous root as has generally been accepted.
He cites the history of the subject as follows:

MIQUEL (1860), speaks of the "tuberous roots" of this plant.

OUDEMANS (1883), speaks of the tuberous roots of the sweet potato as containing much starch.

PETER, speaks of the tuberous lateral roots of the sweet potato as becoming as big as a fist.

ZIPPEL (1896), says of the sweet potato, that the roots are annual and produce several tubers on its rootlets. "Offshoots grow out from the mother root which must be carefully removed and planted."

VELENOVSKY (1917), speaks of Ipomoea and Dahlia as both being examples of tuberous roots.

KOORDERS (1912), speaks of the white, red or yellow tuberous roots of the sweet potato.

VON DER WOLK (1914), speaks of the formation of tubers of the sweet potato as tubers which originate at the roots of the plant as root tubers.

VAN HAAK (1892), speaks of the tubers of the sweet potato and the irish potato as typical examples of metamorphosed stems. He says, "The naked tubers of the sweet potato (and the irish potato) show many buds surrounded by minute scales. These buds are called eyes and each one can produce a sprout." Haak gives his picture of the eyes, three of which have formed sprouts. "Each young sprout, or part of an older plant which is set out as a cutting grows to be a creeping stem which forms roots at the nodes. Some auxiliary buds grow to be long stemmed tubers."

Kamerling says that in his opinion Haak is entirely right and that the contrary opinion is a mistake of some older authors which has been transplanted throughout literature.

He gives several drawings upon which he bases his proof. His figure 2 is a sweet potato with several shoots growing from it. His figure 3 is a cross section of a young shoot of which he says, "One

sees a closed vascular cylinder with its separate groups of tracheal elements." His figure 4 is a cross section of a young root from the sprouting tuber and figure 5 is a cross section of the tuber itself.

Concerning figure 4 (cross section of a root) Kamerling says, "We see the normal structure of the root; no large celled parenchyma are found in the central cylinder." He does not call attention to the direction of the development of the metaxylem, whether it is centripetal or centrifugal. Concerning figure 5 (cross section of the tuber) Kamerling says, "The pith is very noticable with higher magnification it is seen to consist of a large celled parenchyma tissue with relatively large intercellular spaces, just as we find it in the pith of the young shoot." Here again Kamerling has overlooked the only reliable criterion, and that is whether the development of the metaxylem is centrifugal or centripetal.

From this superficial comparison Kamerling says that, "it may be seen at a glance that the sweet potato is a stem and not a root, because his cross section of the tuber reminds him more of the cross section of the young shoot than the cross section of the young root.

Knowing that the critical structural difference between a stem and a root is that in the stem the metaxylem is laid down progressively from the inside toward the outside and in the root the metaxylem is laid down progressively from the outside toward the inside, I therefore made cross sections and oblique sections of small sweet potatoes until I found one that clearly showed the tracheal elements.

My oblique section shows primary tracheal group at six points. The spiral tubes, those belonging to the protoxylem are toward the outside of the section, the annular tubes are just inside of these, and the pitted tubes (those belonging to the metaxylem) are fartherest toward the center of the section. This fact that the metaxylem is laid down toward the center, without considering any others, proves that the sweet potato is a root and not a stem.

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EARLY DEVELOMENTAL STAGES IN THE ALBINO RAT

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The early development of the albino rat has been quite thoroughly investigated by many workers. The extensive literature offers, however, very little information on the time of appearance and duration of the developmental stages of the rat ovum after it leaves the ovary and after it becomes fertilized. Also, some of the early developmental forms of the mature rat ovum lack description and apparently have not been observed in the chain of development from the unfertilized ovum to the time of cleavage. Of the developmental forms of the rat ova described in the literature, all were within the ovary or had reached the tube. No description can be found of the ovum of the albino rat which has been extruded from the ovary and has not yet reached the ostium of the oviduct.

During the course of my work on the time and duration of the early developmental forms of the albino rat two ova were found within the bursa ovarica, which apparently had been ovulated recently and were on their way to the oviduct. One of these ova is definitely in a state of disintegration while the other appears normal. These two ova were found in sections of the right ovary and oviduct of a rat which had been impregnated 12 hours previously. The normal ovum is apparently in a monaster stage preparatory for the formation of the second polar body. The spindle was sectioned transversely and situated near the periphery of the ovum. In this ovum, which can be considered as extra-tubal, the first polar body is not present. In the rat and many other animals the first polar body is formed and degenerates while the ovum is still within the ovary. The second polar body does not form until after fertilization of the ovum which takes place in the ampulla of the oviduct. The ovum is surrounded by a mass of follicular cells arranged in rows like those enclosing an ovarian ovum. These follicular cells show no mitotic figures as do those in the ovary suggesting that the formation of new cells had ceased. The cytoplasm of many of the follicular cells show vacuoles and fragmentation. These follicular cells show a progressive disintegration as the ovum develops and, by the time the ovum has reached the four-cell stage, these cells have entirely disappeared.

Ova in the process of escaping from the ovary have been observed by Sobotta (1895) in the mouse, Longley (1911) in the cat and O. van der Stricht (1909) in the bat. Longley observed that the extra-tubal ovum from the cat has the first polar body and the spindle arranged eccentrically in a monaster. Many follicular cells enclose the ovum.

Two ova were found which present characteristics of an early and a late anaphase stage of the first segmentation division. These were observed in sections of the left oviduct of a rat which had been inseminated twenty-seven hours before the ovaries and oviducts were removed. The mitotic figure of each ovum is situated more nearly in the center of the ovum as compared with the eccentrically placed spindle for the second polar body. The width of these spindles is about 11.2 microns as compared with an average of 6.4 microns for the spindle of the second polar body and 7.4 microns for the spindle of the first polar body. However, since these two ova are the only specimens of this particular age that I have they will deserve further comparison with other specimens of this age before this particular stage of development can be determined definitely. This stage of development is undoubtedly very difficult to isolate because of the short lapse of time involved from the fusion of the pronuclei to the first segmentation division, probably not lasting over a period of more than two or three hours.

Data on the approximate time at which the maturation and segmentation stages appear in the albino rat are lacking in the literature. At the present time it can only be inferred that the first segmenation spindle and the first segmentation division occur a few hours from the beginning of the second day after insemination or about 15 or 16 hours after fertilization considering that fertilization in the albino rat takes place about 12 hours after insemination. Huber (1915) estimates that these stages probably occur about 30 to 32 hours after insemination. The two ova above described as appearing to be anaphase stages for the first segmentation division appear at about the estimated time according to the development of ova from my material. At 24 hours after insemination the fertilized ovum has reached the late pronuclear stage and those at 30 hours have reached the two-cell stage. In the mouse as shown by Sobotta (1895) the conjugation of the pronuclei and the first segmentation division takes place rather quickly, covering a period of only about one and a half to two hours.

The first segmentation spindle has been observed in other animals. Sobotta (1895) describes this particular stage in the mouse ovum and Hill and Tribe (1924) describe an ovum of the cat, which is incompletely divided into two halves by a deep circular groove extending in more than half-way towards the center. Each half contains a small nucleus. In the center, about mid-way between the two nuclei, remains of the spindle-fibers are distinctly visible.

The two-cell stage with resting nuclei extends through a relatively long period. I observed the two-cell stage as early as 30 hours and as late as 45 hours after insemination. Huber (1915)

observed the two-cell stage from a period extending from 42 hours to 70 hours after insemination. Melissinos (1907) observed the two-cell stage in both rats and mice as early as 24 hours after insemination but this investigator does not differentiate specifically between ova of mice and rats in his description.

In conclusion a through investigation has not yet been made to determine the approximate time of appearance and duration of the maturation and segmentation stages of the rat ovum. Data of this sort would be considered of value to others who may desire to collect maturation and segmentation stages in the albino rat.

During the course of this investigation two extra-tubal ova were observed, one of which is normal. This ovum had not yet been fertilized and possessed the monaster for the second polar body.

Two ova each showing characteristics of an anaphase stage for the first segmentation division were observed in material from a 27 hour rat. This stage as yet is uncertain as the period of development in the albino rat from 25 hours to 30 hours after insemination deserves considerable more investigation.

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THE PRESENT STATUS OF CERTAIN MAMMALS IN WESTERN KANSAS

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This paper makes note of the present numerical status of certain mammals in western Kansas. The data presented have been gathered from personal observation, county-wide round-ups, bounty records, and a few other sources indicated in connection with the items concerned.

Questions as to whether certain mammals are on the increase or decrease, or are holding their own, are of both biological and economic interest. The data herewith presented will at least show something of the present trends of animal population.

Both the black-eared jackrabbit, (Lepus californicus melanotus) and the white-tailed jackrabbit (Lepus townsendii campanius) were once common in Ellis county and adjacent counties. Now the white-tailed jackrabbit is seldom seen. In a county-wide rabbit hunt in Rush county on December 26, 1930, 6,200 jackrabbits were killed, of which one was a white-tailed. One month later, another county-wide hunt was held in the same county, in which 11,664 jackrabbits were brought in, six of which were reported to have been of the white-tailed species.

The big snow of March 26, 1931, was said by farmers of Rush county to have killed more jackrabbits that the two hunts above-mentioned together. And still one may travel through Rush county and see a goodly number of the black-eared jackrabbits.

From the county clerk's records in Gove county the writer found that bounties on 111,450 jackrabbits had been paid from December 4, 1926 to April 5,1927, or in four months time. At five cents each it may be seen that this cost the county over $5000 and on the latter date the county commissioners stopped paying bounties. We merely present the figures without comment. Whether some of the rabbit ears came from other counties or not, or from other irregular sources, the figures at least indicate something of the present numerical status of the black-eared jackrabbit.

One porcupine was captured approximately ten miles north of Hays, Kansas, in the fall of 1929. Another was captured northeast of Stockton, Kansas, on Bow creek, during the winter of 1930-31. The writer saw both of these specimens.

Prairie dogs were pretty thoroughly killed off in western Kansas two or three years ago and previously. But in a few places here and there over the state where a few animals were missed, fairly large towns have again developed. In Ellis county, for instance, the writer has visited one town covering several acres, and has been

informed of two or three others. In the case of the town he visited, the farmer told the writer that he hated to see the "dogs" entirely exterminated and had purposely left a mound or two.

Three "red foxes" were reported killed in the northern part of the state during coyote round-ups the past winter. But the writer has had no way of verifying those reports. Two were reported from Mitchell county and one from Jewell county.

There seems to be a fairly common belief among hunters and farmers that coyotes are holding their own, if not actually increasing to some extent. The writer has been collecting bounty records, and coyote round-up records during the past ten months. He has obtained records from eighteen counties, of from one year's bounties to thirty-two years' bounties.

The records are made somewhat uncertain in their indications because of the fact that "bootlegging" has occured. Some of the counties in which this has occurred know of the fact and can make a fair estimate of the extent to which "bootlegging" took place. In other counties an alert county clerk forestalled the fraud.

The following records from Ness county are here presented for two reasons: first, because an investigation seems to indicate that the records are as nearly reliable as any; and second, because the records have been obtained for some thirty years back. From a study of the records of bounties in eighteen counties, including the following records from Ness county, (Table I), the writer rather concludes (in-so-far as any conclusion is possible from bounty records) that for fifteen or twenty years the coyote has held its own, but that previous to that time it was found in greater numbers.

TABLE I

Coyote Bounty Records as Recorded in the County Clerk's Office at Ness City, Ness County, Kansas.

Year	Number	Year	Number	Year	Number
1899	591	1909	410	1919	181
1900	487	1910	418	1920	316
1901	396	1911	[1]	1921	233
1902	449	1912	548[2]	1922	274
1903	312	1913	[1]	1923	238
1904	141[1]	1914	334[1,2]	1924	192
1905	465[1]	1915	231[2]	1925	207
1906	37[1]	1916	261	1926	239
1907	598[1]	1917	217	1927	250
1908	387	1918	242	1928	220
				1929	253

1. Records incomplete.

2. Records somewhat uncertain due to the fact that records of bounties on rabbits, gophers, crows and coyotes were lumped together. Only even dollars were counted as coyote records.

CROTON CAPITATUS AS A POISONOUS FORAGE PLANT

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Abstract

A sample of Croton capitatus was received by the State Drug Laboratory August 22, 1930. The farmer from whom the drug was received had lost a number of cattle and suspected the weed as being responsible.

Tinctures of fresh and dried drug were fed to rabbits in graduated doses. A dose of the tincture representing 2 - 2.5 Gms. of drug was found to kill a rabbit in from 10 to 18 hours. The rabbits used were of mixed breeds averaging 2 to 2.5 Kg. in weight. The animals appeared doped, refused to move or eat and presented slowed reflexes. Death was usually accompanied by convulsive kicking and squealing.

A post mortem examination revealed that the tincture had some rather peculiar effects on the stomach mucose. They were exceedingly necrotic and friable. The body of the stomach was effected most, there being large patches of disintegrated tissue, sometimes white and resembling ulcers, and at other times black and leathery. Other viscera appeared normal to gross inspection.

Small dosage extended over a long period merely accentuated the symptoms of the lethal dose.

Aqueous extractions of the dried drug have been found to have no effect. Distillates of the tincture produced the same effect as the original tincture.

All experiments were controlled with equivalent quantities of ethyl alcohol. None of the symptoms mentioned above were produced in control rabbits.

THE PERIPHERAL NERVOUS SYSTEM OF THE EARTHWORM

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This investigation was undertaken to determine by physiological methods the exact nature of the peripheral nervous system of the earthworm. The mucous system and the dorsal pore muscles were the effectors observed. Pieces of the nerve cord varying in lengths of five to twenty-five somites were removed from the worm.

The body wall in the denervated regions was stimulated electrically and by heat. There was no discharge of mucus or of coelomic fluid. When the body wall of the normal regions either anterior to or posterior to the denervated areas was stimulated, mucus and coelomic fluid were discharged only in the part stimulated. The response was never carried across the denervated part.

Results which depend on the action of the mucous system and the dorsal pores as an indication of the transmission of nervous impulses show that the peripheral nervous system of the earthworm is not a nerve-net but is composed of elements which have definite connections in the nerve cord.

SOLVENTS FOR GUM ARABIC, II

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In a previous communication[1] a report of the solubility of gum arabic in forty organic and inorganic solvents was given. Since then another group of solvents has been tried. The solubility of 1 gram of purified gum aramic in 25cc of solvent was tried at 25°, 50°, and 75°. The following aditional solvents have been tried.

Aliphatic solvents:—Methyl ethyl carbamate, lactic acid, ethyl lactate, formamide, diacetin, ethanol amine, triethanol amine, glycerol monochlorhydrin, glycerol dichlorhydrin, trimethylene glycol, propylene glycol, ethylene glycol monomethyl ether, ethylene glycol monobutyl ether, dioxane.

Aromatic solvents:—Benzyl alcohol, ortho-cresol, para-cresol, ethyl ether of meta-cresol, furfural.

The results for practically all of these solvents were negative in character. Triethanol-amine and ethanol-amine dissolved about 0.5 grams of the gum in 10cc of solvent after being heated to 75° and allowed to stand for three days at 25°. Lactic acid showed some tendency to dissolve the gum at 25° and upon heating to 75° and allowed to stand for two days one gram of gum dissolved in 25cc of solvent.

Solubility determinations using glycerine and ethylene glycol (reported as negative in our first communication) were repeated. It was found that gum arabic dissolved very slowly in these solvents, but by heating to 75° over a period of several days and thus reducing the viscocity, quite appreciable amounts dissolved. In the case of ethylene glycol the extent of solubility was 1.4 grams in 25cc and remained in solution when cooled to room temperature.

It is interesting to note that all of the above solvents contain hydroxyl groups and the better ones contain two or three hydroxyl groups. When one or two of the hydroxyl groups of glycerol were changed to the chlorhydrin no solution took place. Likewise the ethers of glycol had no solvent action. One of us reported that liquid ammonia[2] at its boiling point seemed to disperse gum arabic very slightly but at room temperature the dispersion was much less.

It is interesting to note that gum arabic, which is so readily soluble in water, is so extremely insoluble in the large number of solvents tried. Evidently it must undergo considerable solvation as it goes into solution; other solvents evidently do not have this ability to produce the necessary solvation. Further we have pointed out[3] that gum arabic behaves in solution as an electrolyte, i. e., it is

ionically dissolved. As the conductance ratio of this material in water is high it is evident that a large portion of the material present is in the ionic state. The ability of the water to cause this ionization would be an added cause for solution in this solvent. In this connection, Walden[4] has pointed out that there is a parallelism between high dielectric constant (indicating great dissociating power of a solvent) and a high relative solubility of a given solute.

If we can draw any conclusions from our somewhat meager data it seems probable that a liquid in order to be a solvent for gum arabic must possess one or more hydroxyl groups and at the same time possess a relatively high dielectric constant. The liquids in which gum arabic was obtained in solution possessed both of the requisites. On the other hand the presence of hydroxyl group (or groups) alone did not cause solution (some of the chlorhydrins for example). No solubility was noted in formamide, a liquid which possesses a higher dielectric constant than water, but does not possess a hydroxyl group in its molecular structure.

A complete list of solvents tried is given below:

Aliphatic alcohols—Methyl, ethyl, propyl, amyl, butyl, glycerol, glycerol monochlorhydrin, glycerol dichlorhydrin.

Aliphatic esters—Ethyl acetate, 40 per cent ethyl acetate and 60 per cent ethyl alcohol, 40 per cent amyl alcohol and 60 per cent amyl acetate, ethyl butyrate, ethyl caproate, diethyl carbonate, ethyl aceto-acetic ester, methyl ethyl carbamate, ethyl lactate, amyl acetate.

Miscellaneous Aliphatic solvents—Formic acid, acetic acid, lactic acid, formamide, diacetin, ethanol amine, triethanol amine, diethyl ether, dichlorethyl ether, acetone, chloroform, carbon tetrachloride, carbon disulfide.

Ethylene derivatives—Ethylene glycol, trimethylene glycol, propylene glycol, ethylene glycol monomethyl ether, ethylene glycol monobutyl ether, dioxane, dichlorethylene, trichlorethylene.

Aromatic hydrocarbons—Benzene, toluene, xylenes.

Aromatic derivatives—Phenol, ortho-cresol, para-cresol, ethyl ether of meta-cresol, nitrobenzene, aniline, dimethyl aniline, ethyl benzoate, benzyl benzoate, diphenyl ether, chlorobenzene, 40 per cent aniline and 60 per cent benzene, 40 per cent toluene and 60 per cent aniline, benzyl alcohol.

Other solvents—Pyridine, liquid ammonia, furfural.

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MODES OF VAPOR DIFFUSION IN SPARK DISCHARGES

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It is common knowledge that the integrated luminous effect of a condensed electrical discharge in air at normal pressure varies at different points in the gap region; also that the diffusion of metallic vapor from the electrodes composing the discharge gap may take place in one of several modes.

The discovery of the vapor lines in the gap space at the time of a spark discharge can be attributed to Schuster and Hemsalech[1] who, in 1889, made the first spectrograph of a slit illuminated by an electric spark, the spectrum being photographed after reflection from a rotating mirror. Their work not only revealed the fact, that the initial lines are generally air lines which are followed by the vapor lines of the material employed as gap terminals, but it also afforded a means for determining the approximate velocity of diffusion of the various vapors resulting when different metals are employed as gap terminals.

It remained for Beams[2], however, to determine the actual time interval between the appearance of the respective lines of any one substance constituting the spark gap terminals. This interval is of the order of 10^{-8} seconds. But remarkable as this discovery is, it is yet a question as to what specific conditions will produce a particular mode of diffusion. As surmised by Beams[3], the diffusion of vapor resulting from a spark discharge may take place in more than one way. In fact, he suggests either "jets of luminous vapor or pulses of luminosity in the vapor".

In a recent number of the Physical Review[4], the writer submitted two shadowgraphs of sparks substantiating the conjecture of "pulses of luminosity in the vapor". The purpose of the present paper is to further discuss another mode of diffusion as observed by the writer and to present data covering the disposition of apparatus under which these respective modes took place.

The general arrangement of the apparatus responsible for the present plates and discussion is fully described in an earlier paper[5]. The particular modes of diffusion considered herein, apply to the condition where the object gap, that is, the gap being studied, was paralleled by a micrometer side gap located outside the camera. It was with this arrangement that the most fruitful results of early or young sparks was obtainable. Furthermore, it is in the early stage of a spark that diffusion sets in.

The particular modes of diffusion observed by the writer may be classified as (1) periodic luminous pulses shown in Fig. 1; (2) non-

periodic luminous pulses; and, (3) jets of luminous vapor represented by Fig. 2. The data covering the production of these modes of diffusion appears in a table below.

Fig. 1. Periodic Pulses

Fig. 2. Jets

Data on Disposition of Apparatus

Fig. No.	Terminal Gap cms	Illuminating Gap cms	Retarding Capacity e. s. u.	Side Gap cms	Object Gap cms
1.	2.5	2.375	18,590	3.20	3.0
2.	3.0	2.050	15,730	3.20	3.0

Beams[3] pointed out that photographs of sparks reflected from a rotating mirror exhibit first a bright streak completely across the gap space, the streak being a discharge through air as indicated by air lines in the visible spectrum of the streak. Following the bright streak are luminous streamers emanating from the electrodes, and commencing at the cathode. These streamers evolve with each half oscillation and move with diminishing velocity until they reach the moving vapor front.

Fig. 1 verifies this hypothesis exactly but instead of being an integrating effect as the rotating mirror photographs of Beams, it represents an instantaneous aspect of the spark of the order of several microseconds[7]. Here, as in Beams' photographs, the diffusion is also more active at the cathode than at the anode of the gap. Furthermore, it is possible to discern the individual pulses (streamers) representing half oscillations in the discharge. The original negative shows approximately ten of these half cycles which for an exposure of three microseconds as determined by means of sound photographs, would imply an oscillation period of the order $6x10^{-7}$ seconds or a frequency of approximately sixteen thousand kilocycles. In the work previously mentioned[4], the writer presents a photograph illustrating earlier conditions or rather an earlier stage of the spark than that of Fig. 1 above, but pertaining to the same type of discharge. There the diffusion is just commencing at each electrode. It is interesting to note that of numerous spark photographs by the writer, every one indicates a more rapid diffusion from the cathode than from the anode.

Mode (2), non-periodic pulses, will not be illustrated in this paper although the author possesses numerous negatives depicting this particular mode of diffusion. He advances the supposition that this mode is a transition from pulse diffusion to jet diffusion.

A comparison of the data showing the circuital conditions under which the present discharges took place, will reveal the following differences: (1) the gap distances of the static generator terminals is a full centimeter greater for Fig. 2 than for Fig. 1, (considering the two sets of terminals as a series connection); (2) the illuminating gap space for Fig. 2 is approximately 3.25 millimeters less than that for Fig. 1; (3) the capacitance retardation for Fig. 2 is approximately only four-fifths as great as that for Fig. 1.

Assuming a dielectric strength for dry air at approximately 33,000 volts per centimeter, this means that in the case of Fig. 2, the potential difference across the terminal gaps was considerably enhanced by the increased gap distance, due allowance being made for ionization from previous discharges. Consequently, the total quantity of electricity dissipated in the discharge for Fig. 2 was comparatively greater than that for Fig. 1. Moreover, since both the illuminating gap space and the retarding capacity are smaller in the case of Fig. 2 than that of Fig. 1, the augmented charge is going to break down with increased facility, to the extent that periodic diffusion is out of the question. The situation approaches one of diffusion under forced pressure.

In a paper on the "Mechanism of a Condensed Spark Discharge" the author[6] discusses this particular aspect of the spark discharge

from a different standpoint calling the configuration in the gap space "globules and molecular aggregations". However, from the standpoint of modes of vapor diffusion, it seems more appropriate to style it as "jets of luminous vapor".

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NOTES ON FOSSIL LAGOMORPHS

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After a critical study of the teeth of fossil rabbits, it seems possible to distinguish at least five groups based on the character of the enamel folding on the lower $P\overline{3}$. This tooth seems to show an interesting series of variations which are remarkably distinct in each group. Although there are variations of importance in other teeth, such as in $M\overline{3}$ in the lower jaw and in $P\underline{2}$ and $M\underline{3}$ in the upper jaw, the molar teeth as a whole show very few variations and seemingly have changed little since the first known true rabbits from the lower Oligocene.

On the basis of the character of the enamel folding on $P\overline{3}$, I have divided all of the Leporidae into five groups. The variations and the distribution of the types, give strong support for the decision to assign each to the rank of a sub-family. It is confidently expected that future research will confirm this conclusion. The following brief descriptions reveal the distincive characters of the subfamilies.

Subfamily Protolaginae

This subfamily is based on the character of the enamel folding on $P\overline{3}$. As observed, $P\overline{3}$ differs from that in all other of the subfamilies in having two internal re-entrant angles or enamel folds. The major internal re-entrant angle separates the tooth into two columns and apparently meets the single external re-entrant angle. A narrow bridge connects the two columns. The second internal re-entrant angle is only faintly developed and is very narrow, but extends nearly half way across the posterior column of $P\overline{3}$. It is probable that this second internal re-entrant angle would be missing in old teeth, thus reducing them to the condition of Palaeolagus.[3] However, a number of very young individuals of Palaeolagus have been examined and they do not show this character. This is further proof of the significance of this character in the Protalaginae. The anterior column is smaller than the posterior column and somewhat separated from it.

Subfamily Palaeolaginae Dice[11]

This subfamily is distinguished by the character and number of the re-entrant angles or enamel folds on $P\overline{3}$. In this subfamily $P\overline{3}$ has a single external and a single internal re-entrant angle. The two re-entrant angles nearly meet in the center and although separating the tooth into an anterior and a posterior column, the two columns are connected by a narrow bridge, composed of two ridges of enamel. The tooth in transverse section has thus something of an "hour-glass" figure. The anterior column is only slightly smaller than the posterior column.

Subfamily Megalaginae

In this subfamily $P\bar{3}$ has varied considerably from the conditions characteristic of the preceding subfamilies, and has only a single external re-entrant angle or enamel fold, there being no evidence of an external re-entrant angle. The single external re-entrant angle does not extend to the center of the tooth. This tooth now has the form of a cylinder with the external side somewhat compressed and with its external re-entrant angle again dividing the tooth into two columns of nearly the same size.

Subfamily Archaeolaginae Dice[11]

This subfamily has characters approaching the modern Leporinae in the folding of the enamel on $P\bar{3}$. In the subfamily Archaeolaginae, $P\bar{3}$ is characterized by the presence of two external re-entrant angles, but no internal re-entrant angle. The main external re-entrant angle is posterior, and does not extend more than half way across the crown. The anterior re-entrant angle is very shallow, being only a slight indentation with a faint ridge on either side. The main external re-entrant angle divides the tooth into two columns, of which the posterior is slightly smaller than the anterior one.

Subfamily Leporinae Dice[11]

This subfamily, which includes most of our modern hares and rabbits, is again characterized by the enamel folding on $P\bar{3}$. In this subfamily $P\bar{3}$ has two external but no internal re-entrant angles. The main external re-entrant angle, which is posterior, reaches entirely across the tooth, and is in contact with the internal side of the crown. The anterior external re-entrant angle is shallow, not extending to the center of the tooth. The tooth now consists of three columns, the posterior one almost completely separated from the two incomplete anterior columns. The posterior column is considerably smaller (antero-posteriorly), than the two combined incomplete anterior columns. The anterior external re-entrant angle shows a number of interesting variations in the different genera of this subfamily.

Summary

If we may assume that the character of the enamel folding on $P\bar{3}$ is indicative of the relationship of the Leporidae, then the changes observed in this tooth show that it has developed into its present form by the following steps: (1) the loss of the internal re-entrant angle of the early forms; (2) the increase in size of the anterior column over the posterior column; (3) the addition of a second anterior external re-entrant angle; (4) a general lengthening of the anterior column of the tooth (anterio-posteriorly).

Conclusion

This study of the teeth of fossil Lagomorphs shows clearly how little the teeth have varied during the evolution of the group. If there has been any great change in the structure of Lagomorphs since early Oligocene time, it has affected other parts of the skeleton, namely, length of limbs and size and manner of carrying the head, rather than any profound changes in dentition. The type of dentition acquired by the early Oligocene Lagomorphs, has been adequate to fit rabbits for nearly every type of food habitat that they have been subjected to since that time. It is clear that the teeth have remained largely in the early primitive condition, while the feet have had to carry and solve the problem of maintenance.

From the amount of material which has been collected in the last few years, it is evident that Lagomorphs were very abundant during Oligocene time. Hundreds of jaws and fragments of skulls may be collected from the washes in the badlands. The choice localities, which seem to be associated with the Nodular layers in the Oreodon beds, may show that the Lagomorphs had already preferred the open, possibly arid conditions, of which these Nodular layers seem to be indicative.[12]

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THE SPERMATOGENESIS OF THE MEADOW VOLE MICROTUS PENNSYLVANICUS

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Introduction

To my knowledge, no cytological study has ever been made of Microtus pennsylvanicus, meadow vole. The wide distribution of this species, together with the fact that these animals are easily bred in captivity, make it desirable that a study of the morphology of the chromosomes, the correct chromosome count, and the type of sex-chromosomes be determined.

Material and Methods

The testes of eight adult meadow voles, one half grown specimen, and fragments of the amnion from three half mature embryos form the material for the present study.

Allen's modification of Bouin's fluid was used for fixation and the tissue was subsequently treated by the drop method. Sections were cut six to nine micra thick, those cut at eight being the most satisfactory for study. Iron-hematoxylin was the principal stain employed. Several slides were stained with Flemming's triple stain, and these proved valuable in the study of the chromatin nucleoli. Eosin was employed in some cases as a counterstain but the results obtained were not particularly useful in the study.

Perhaps one point in regard to breeding might be of interest to anyone wishing to carry on breeding experiments. It was found that when individuals were mated and placed in a small cage, litters very seldom were obtained. The animals are gregarious in nature, and the best results were secured by placing several males and females in a larger cage, 34 in. x 36 in. with about six inches of fine hay. They chose their own mates and each pair made a nest of its own before the birth of its young.

Spermatogonial Divisions

A considerable amount of time has been devoted to a study of spermatogonial chromosomes so that they could be recognized in the equatorial plate views. About fifteen spermatogonial plates were counted and in nine cells all the chromosomes could be identified. These cells gave a consistent count of 42 (Figs. 1-6). The counts in the other six cells ranged from 35 to 40.

For the most part, the chromosomes in this stage appear as short thick rods, elongated rods and comma shaped ones. With the ex-

1. This paper has been worked out under the direction of Dr. W. J. Baumgartner. His advice, guidance and criticism have been very helpful.

ception of one relatively large pair and several small ones, the chromosomes are made up of medium sized elements that do not vary much in size. Figs. 3 to 6 show rather late metaphase views in which the chromosomes have begun to move apart. It will be noticed that the

Chromosomes appear somewhat thicker due to the fact that a slight division has already started. Fig. 3 shows one chromosome in which the split can already be seen.

As will be noticed in the figures the chromosomes have mates of approximately similar size and shape, with the exception of two for which no such mates could be found. These are labeled "X" and "Y". The "Y" is the smallest element in the cell, and in the dividing stage usually lies near the center of the plate. The "X" is a long, thin, medium sized element. Due to the fact that there are an even number of chromosomes and that two elements have no mates of like size, it is concluded that the sex chromosomes are of the X-Y type. An approximate alignment of the chromosomes in cells 1 and 4 are shown in Figs. 29 and 30.

Counts were made in several metaphase views in amniotic cells as shown in Fig. 7, and the number is undoubtedly 42. The cells of the amnion are larger than the germ cells and the chromosomes are longer. No X-Y elements could be identified but it is possible that this cell is from a female embryo having an XX complex.

Primary Spermatocycle Division

Following the telophase of the last spermatogenial division, the chromosomes seem to swell, stain less densely and become diffuse, (Fig. 8). Two elements stain more deeply than the rest and persist in a later stage (Fig. 9). The diffusion process continues until a reticular resting stage is reached (Fig. 10), in which two chromatin-nucleoli are seen, the smaller one of the two staining more intensely. After a resting stage, the primary spermatocyte enters into a growth phase. The reticulum of the resting nucleus changes to a delicate spireme (Fig. 11). These leptotene threads thicken and stain more densely, (Figs. 12, 13).

The distinct bouquet stage described by so many investigators was not observed in the meadow vole material. The ends seemed to terminate at different places along the nuclear wall, (Fig. 14). The spireme threads thicken and shorten into the pachytene stage and there is a definite suggestion in many cells, (Fig. 14), that these threads pair, beginning at the nuclear wall. The diffuse stage follows, (Fig. 15), that has been described by Wilson '12 and other writers. At the end of the diffuse period, the nuclei undergo a rapid change in which the diffuse diplotene threads condense, contract and increase in staining capacity, the darker stain first appearing in de-

finite knots along the threads, (Fig. 16). The chromatin further contracts into rings, U's, and other shapes characteristic of the late diakinetic period. In late diakinesis, (Fig. 18), the chromatin all stains with so nearly the same degree of intensity and forms such varied shapes that it was impossible to locate the nucleolus with any degree of certainty. However, as the tetrads began to take on more definite shapes, the nucleolus could be distinguished again by its deep stain and clear-cut outline. It could be followed to the first maturation division, (Figs. 19-21), where it divided into two unequal parts. These have been designated as the X and Y, (Figs. 22-23). A side view of the spindle is shown in Fig. 24, showing the X and Y and an early division of one tetrad, each dyad having passed to its respective pole. An early division of this same element appears in Fig. 21. In no cell could more than twenty tetrads be distinguished, (Fig. 23).

An alignment of the haploid elements, (Fig. 28), shows the shapes for the most part to be long club-like, "derby hat", dumbbell and short thick rods. The short, thick, bent tetrad is also present.

A small, round, intensely staining chromatoid body appears in many of the spindle views, (Fig. 23). In views where this element can be seen, it is always at one side of the spindle about 4.2 microns distant from the tetrads. In the second spermatocyte division, the chromatoid body sometimes appears at one of the poles before the division of any of the dyads, (Fig. 25).

Second Spermatocyte Division

Metaphase views of the second spermatocyte division were observed rarely, but in four cases counts were made. Two early metaphase views were found, (Figs. 25-26), in which the chromosomes were well scattered and easily counted. Fig. 25 shows twenty-one chromosomes. In Fig. 26 the large chromosome appearing at the extreme left in Fig 25, has already divided, making a total of twenty-two chromosomes in this cell. Fig. 27 shows a late anaphase with twenty-one chromosomes passing to one pole and nineteen to the opposite pole. The section is cut somewhat obliquely, and it is quite probable that two of the chromosomes were sliced off at one end.

Summary and Discussion

Fifteen spermatogonial metaphase views have been studied; and 42 chromosomes found in nine of them, the other counts ranging from 35 to 40. The haploid number is 21 in three second spermatocyte metaphase views and one anaphase view. Young somatic cells show the diploid number. Recent studies of rodent spermatogenesis show that, with the exception of the guinea-pig, the chromosome numbers lie between 40 and 42. Painter '26 and Pincus '27, found 42 spermatogonial chromosomes in the albino rat. Pincus '27, found 40 to be the diploid number in the black rat. Cox '26, found 40 spermato-

gonial chromosomes in the house mouse. League '28, in a study made on the guinea-pig, placed the diploid number at 62±2. However, in the late prophase, the number was found to be approximately 40, but due to probable fragmentation the equatorial metaphase view shows a greater number.

The conclusion that the meadow vole has the X-Y type of sex chromosomes is drawn from the fact that there is an even number of chromosomes, two of which fail to pair, and that one tetrad divides early with an unequal division. All of the above mentioned studies on rodent spermatogenesis agree as to the presence of the X-Y type of sex chromosomes.

In the mataphase of the first maturation in the meadow vole, a characteristic black, cleancut element that appears to be a chromatin nucleolus, divides into the X-Y elements. Little positive evidence has been given in mammalian cytology that the chromatin nucleolus goes to make up the sex chromosomes. Stevens '11, who worked on the guinea-pig favors such a conclusion, and Painter '24 in his work with the opossum, gave a detailed account of the fate of the chromatin nucleolus, and he is of the opinion that the nucleolus forms the sex chromosomes in the opossum. More evidence for such an hypothesis is found among insect materials.

In the meadow vole a plasmosome and a chromatoid body were observed in certain stages. In all the studies of rodent spermatogenesis cited, a plasmosome was present but no chromatoid body was mentioned. Painter '24, found such a body in the testes of the horse. Wodsedalek '14 described this body in detail.

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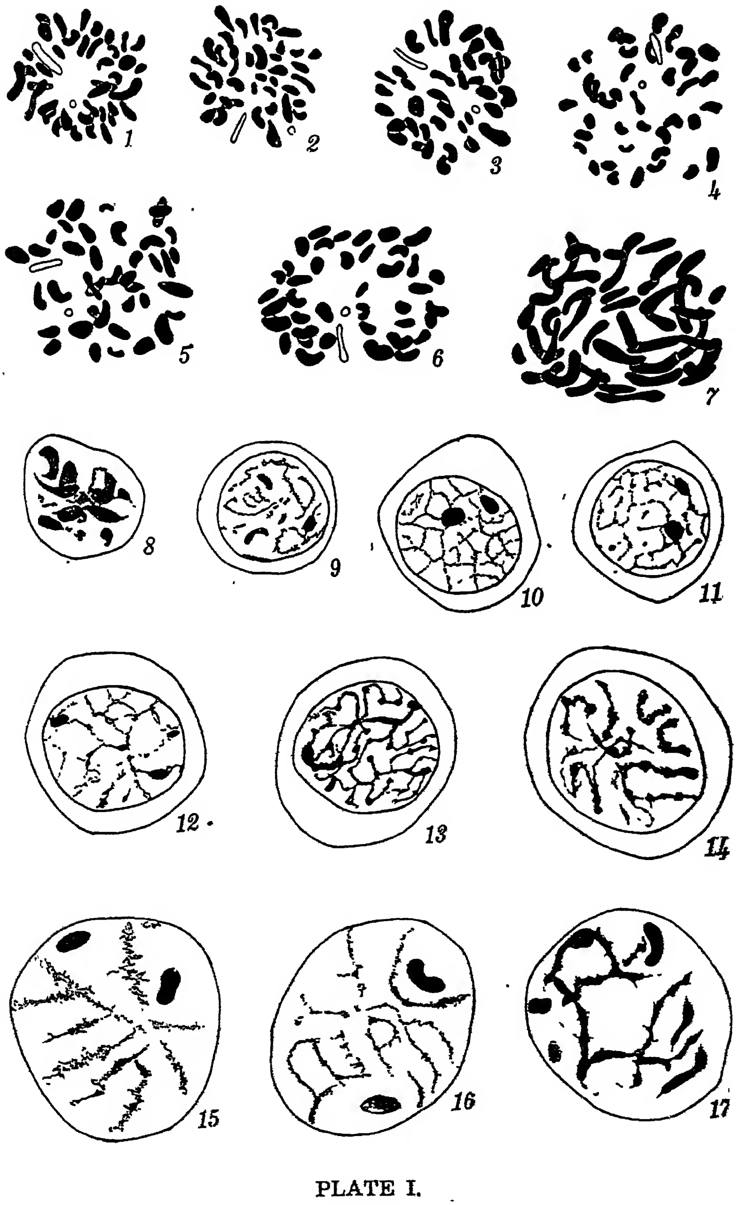

PLATE I.

Explanation of Plates

The figures were drawn at approximately 2275 magnifications. A camera lucida was used with a B. and L. scope, 2mm apochromat oil-immersion lens and a No. 20x ocular. Drawings were made at a level with the mechanical stage.

Explanation of Figures

PLATE I.

1. A metaphase plate view of second spermatogonia, showing 42 chromosomes. The accessories are shown in outline.

2. Dividing spermatogonia, showing 42 chromosomes.

3-6. Later metaphase views showing 42 chromosomes.

7. Prophase stage from the amnion of an embryo, showing 42 chromosomes.

8. Late telophase of spermatogonial division.

9. Early resting stage of primary spermatocyte.

10. Resting stage, primary spermatocyte, showing a chromatin nucleolus and a plasmosome.

11-12. Early spireme stages.

13-14. Leptotene stage.

15. Diffuse stage.

16. Diplotene stage.

17. Early diakinesis.

PLATE 2.

18. Later diakinesis.

19. Early prophase of first maturation division.

20. Later prophase of first maturation division.

21. Late prophase of first maturation division.

22. Spindle dissection of primary spermatocyte.

23. Spindle dissection of primary spermatocyte, showing 20 tetrads and a chromatoid body.

24. Side view of first maturation spindle.

25. Metaphase view of second spermatocyte, showing 21 chromosomes.

26. Metaphase view of second spermatocyte.

27. Early anaphase view of second spermatocyte division.

28. Tetrads from first maturation spindle, showing individual shapes.

29. Serial alignment of chromosomes from cell Fig. 1.

30. Serial alignment of chromosomes from cell Fig. 4.

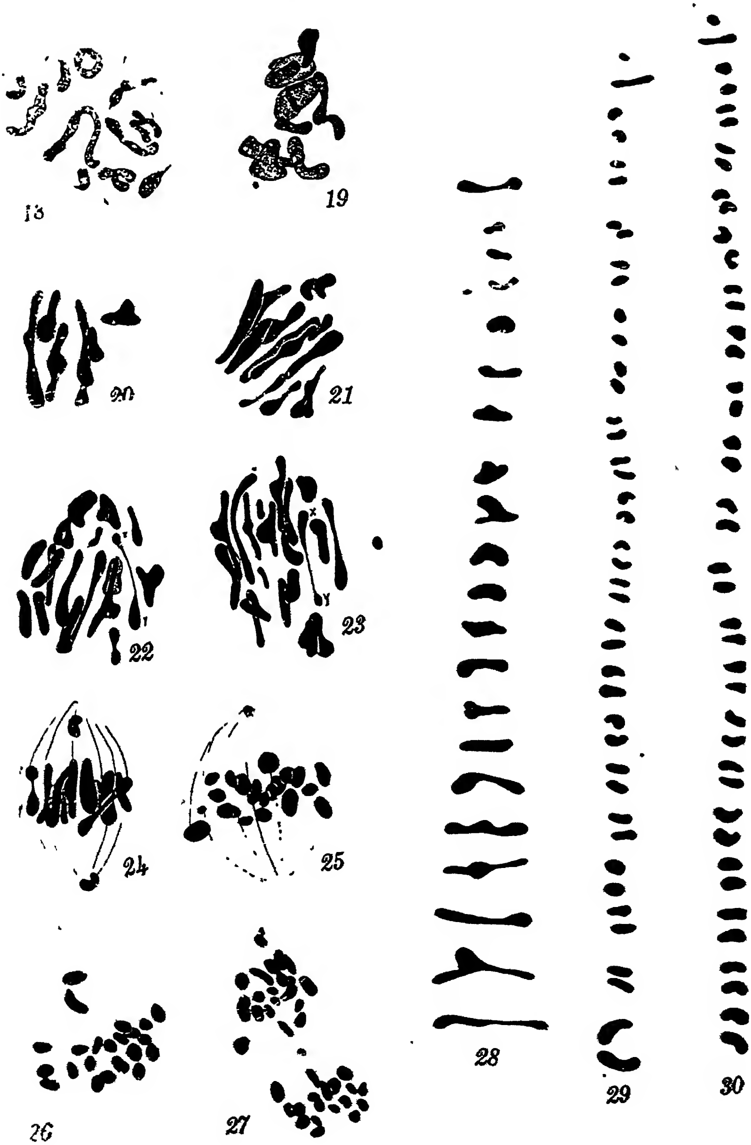

PLATE II.

THE GROSS ABNORMAL ANATOMY OF A TWO-HEADED CALF

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Introduction

The monstrosity in question was a female calf, characterized internally by a decided duplication of the anterior organs, externally by two heads, necks, and vertebral columns, on a single body.

This calf was born on the farm of Z. J. Worthington, near Liberal, Missouri, June 10, 1929, of mixed Jersey and Holstein stock. Since forceful extraction was resorted to, in a futile effort to save the cow, the veterinarian, J. H. Hasson of Mulberry, Kansas, deemed it necessary to remove the intestines. The calf was given to the Biology Department of the Kansas State Teachers College, Pittsburg, where it was skinned and preserved.

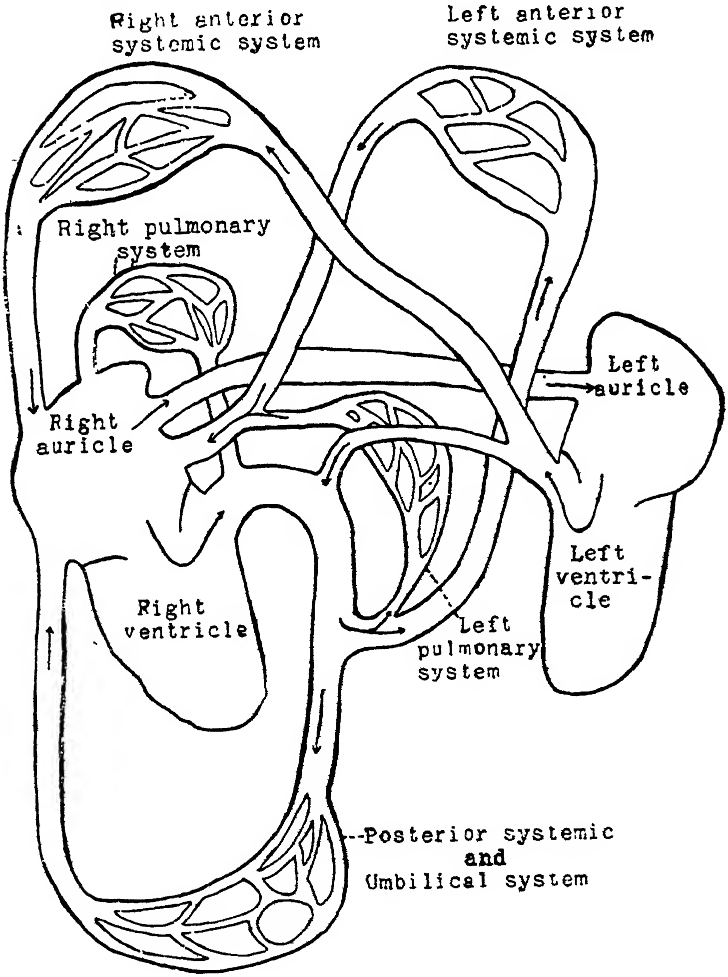
In September, 1930, Miss Ellen Guinn began to dissect this monstrosity with the view of working out the abnormal anatomy. After some work had been done, the writer, in collaboration with Miss Guinn traced the scheme of circulation and noted the skeletal deformities and the most important abnormalities. The finer details were not completed.

Externally, the calf was almost perfectly bilaterally symmetrical, both in color markings and in shape. In color it was dark cherry red, with white on belly, chest, shoulders, noses, and foreheads. The vertebral columns began separating in the anterior coccygeal region, diverging more and more cephalad. The necks were separate about 8 cm. back of the ears, that is, they were united 4 cm. anterior to the tip of the scapulae; the only departure from symmetry being the slightly smaller left head with a smaller white forehead patch than the right.

The chief skeletal deformities consisted of an almost complete double axial skeleton, each axis having a complete set of ribs and terminating in a cranium. The vertebral columns, at the first thoracic vertebrae, were 9 cm. apart; at the first lumbar the centra were loosely bound together by ligaments; the fourth and fifth lumbar vertebrae being solidly grown together. The neural canals became confluent in the first sacral vertebra, the spinal cords uniting in the third sacral and termining in the fifth. The ribs articulating with the left side of the left vertebral column and the right side of the right column were practically normal; ventrally they were attached to a normal sternum. The set of ribs between the two vertebral columns were necessarily much shortened. These ribs were attached to their respective vertebrae at approximately their normal angles,

but curving upward and forward, the first four attaching to an improvised sternum which extended forward to the point of union of the necks. Posterior to this dorsal plate, the ribs united in the middle line, forming a third spinous process. No trace of a second pair of scapulae could be found.

The visceral variations were duplications, or tendencies toward duplications.



SCHEMATIC CIRCULATION OF A TWO-HEADED CALF.

The thymus glands were normally lobed, a pair for each neck, but they were considerably enlarged.

There were two complete and separate sets of lungs, a trachea running its normal course from each head to the bifurcation. Here a small bronchus branched out perpendicularly from each trachea, rebranching to the underdeveloped left lobes of the right lung and right lobes of the left lung. The remaining bronchii coninuing in a straight line along the inner margin of their respective lungs, bronchioles branching out perpendicularly. The tip of the left diaphragmatic lobe of the left lung was redoubled about 5 cm.

The esophagi ran their normal courses to the diaphragm which they pierced 6 cm. apart. The stomach, except the abomasum, was double; the reticula being entirely separate, the rumina and posterior half of the omasa having their median walls in common, the division between the omasa extending nearly half the length of the abomasum. There was a single pyloric opening so the intestines were evidently single.

The liver was practically normal except the left lobe had ruptured the diaphragm and had pushed a tongue shaped lobe 7 cm. long and 4 cm. wide, through into the thoracic cavity.

The circulatory system showed a fair degree of duplication in the anterior part only. (see Fig. 1).

The pericardial cavity was single. It contained a large functional right heart, and a small non-functional clump of cardiac tissue about one-third the dimensions of the large heart, which was presumably the remnant of a left heart. The texture of the walls of the functional heart was practically the same on both sides; the septum ventriculosum being slightly bulged into the left ventricle thus increasing the size of the right ventricle at the expense of the left. The auriculo-ventricular valves were normal. The right atrium was large and received all the veins except the great coronary. The foramen ovale in the atrial septum was rather large and was guarded by a flimsy valvula foraminis ovalis. The left atrium was small and received no veins except the great coronary. The right ventricle discharged through a large artery, which gave off a small pulmonary artery to each lung, then continued upward as the duct of Botalli, which was so large that it had evidently displaced the normal aortic arch, most of the blood to the dorsal aorta flowing through it. The left ventricle discharged through a smaller artery, which after passing dorsally to the duct of Botalli, gave a small branch into the beginning of the convex surface of the arch and continued as the brachiocephalic trunk divided normally with these exceptions: (1) a branch from the left common carotid artery to the dorsal plate, analogous

to the internal thoracic; (2) the right vertebral, deep cervical, and costo-cervical arteries arose by a common trunk; (3) the right internal thoracic arose from the brachial artery rather than from the brachio-cephalic trunk, and (4) there were no left brachial, vertebral, cervical or dorsal arteries.

The dorsal aorta divided perpendicularly about two cm. posterior to the termination of the descending aortic arch, making an artery for the left head analogous to the brachio-cephalic trunk. The abnormal branchings of the duplicate brachio-cephalic trunk were (1) a large right common carotid, arising 1 cm. to the right of the internal thoracic artery, (2) a short trunk receiving a little aorta from the nonfunctional heart; and giving off an artery running parallel to the little aorta, to supply the lungs and left heart tissue, and a small left common carotid, (3) a second left common carotid artery running parallel with the little carotid and uniting with it the lower mandibular region, and (4) the deep cervical and vertebral artery arising by a common trunk, and costo-cervical and sub-costal arteries directly from the brachial artery.

In the systemic venous system, the common posterior vena cava and the azygous vein and the right innominate veins of the right body had few abnormal variations. The left innominate vein arose from the union of a right external jugular vein from the left head, a left external jugular vein from the right head, and a small internal thoracic from the dorsal plate. It received no brachial, internal jugular or dorsal veins. The veins from the left head and left thoracic region united almost normally to form a duplicate superior vena cava which curved inwardly and posteriorly from the union of the brachial and dorsal veins. It passed directly through the left heart, emptying into the lower left margin of the right auricle.

The pulmonary veins of the right set of lungs, consisting of one left and two right trunks, emptied into the middle dorsal wall of the right atrium; those from the left set of lungs, a right and left trunk emptied into the duplicate vena cava at the left margin of the left heart.

In summation, the chief deformities of this calf were: (1) the anterior dividing of the axial skeleton, (2) a tendency toward duplication of the organs, (3) shifting the pulmonary veins to the right ventriole, and (4) supplying of blood to the left anterior and entire posterior body regions, for the most part, by the right ventricle, due to the displacement of the normal aortic arch by the duct of Botalli.

KANSAS BOTANICAL NOTES, 1930

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The spring of 1930 was extremely late on account of the late cold winter and resulted in the development of fewer tree seeds than is usual. The summer was unusually hot and dry until about the middle of August. The effect was felt most on the ground flora, making collecting particularly poor during the year.

During the year we received virtually a complete collection of the flora of Saline county from John Hancin, totaling about 650 specimens. We also received from S. V. Fraser of Aurora, an equally complete collection from Cloud county, totaling about 650 species. In both cases these collections more than doubled the previous recorded flora of those particular counties. The speciments are to be incorporated in the Kansas State Herbarium at Manhattan. A smaller collection was received from Anna A. Jacobs in Cherokee county.

Perhaps the most interesting specimens in these collections were: Panicum ovale well established in the region of a permanent spring near Brookville. It is known elsewhere only from the southern coastal region of United States. Panicum pseudopubescens is collected for the first time west of the Mississippi River.

The hybrid Baptisia whose parents are Baptisia australis and Baptisia bracteata was found this year in Saline county by J. Hancin.

A plant of Apocynum cannabinum collected by S. V. Fraser (407) in Cloud county had remarkably long follicles (16 cm. as against the usual 7 to 10 cm.).

The new growth of trees during the fall, together with late frost, kept the leaves on many trees much longer than usual. This was most striking in the case of the horse chestnut (Aesculus hippocastanum) (November 18, 1930).

December was, on the whole, a very warm month. The warm weather continued into January, 1931, and for the first time in at least eight years dandelions blossomed in January. Several years have had dandelions blossom in December past Christmas, but this is the first year for a long while that any have continued to bloom into January.

In Cherokee county during September observations were made on a herd of hogs which were observed eating the sneezeweed, Helenium tenuifolium. Whenever a hog ate a mouthful of the sneezeweed, vigorous sneezing followed within thre or four seconds and no sneezing was observed except immediately following the eating of the

weed. The ground was very dry as it was near the end of the drouth and very little was available for the animals to eat. Two goats running in the same field ran in and out among the sneezeweed plants, but during the period of observation were not observed to take any. The irritating effect was rather easily gotten because collecting a group of plants and inserting them into the field press was followed by sneezing in my own case.

An unusual fasciation in ash, Fraxinus lanceolata, was brought in by G. C. Munson of Geary county. The stem below appeared essentially normal, but the 1930 growth took place from the two buds at the side of the terminal bud and resulted in two incoiled fasciations about 2 cm. wide in the widest part; the one about 25 cm. long, the other about 12. At the nodes the buds were numerous and altho grouped somewhat, were much more numerous than usual. The very tip of the fasciation was a group of buds starting from about 1 cm. back from the tip on each side and following the edge to the tip. A smaller number were on the broad faces. A few buds were unusually large, but the majority were about normal. One branch which came out from the 1929 growth below the tip was perfectly normal, but a second branch farther down had at the node a twin and a single bud. The specimen exhibited is but one of several that were present on the tree.

Out of a hundred seeds of honey locust, Gleditsia triacanthus, which Prof. W. E. Davis has kept corked under tap water for the past two years, but nine have shown any signs of germination, yet whenever he takes the seeds and opens the coat, they germinate promptly. Several seeds of Abutilon were put in water some 20 years ago. Two of these seeds, when tested in 1930, germinated. He still has four of the original seeds left.

Some thin-shelled black walnuts, Juglans nigra, were found along a creek west of Manhattan, Kansas, in 1921. Trees from these nuts bore nuts in 1930. They were thin-shelled. The shells are from 1-2 to 2-3rds as thick as the ordinary black walnuts, but there does not seem to be any difference in the taste of the nutmeats.

F. F. CREVECOEUR—A VERSATILE KANSAS NATURALIST 1862-1931

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Near Onaga, Kansas, has lived for sixty years, an enthuiastic naturalist of broad interest. Most biologists have known him only by correspondence or through his papers published largely in the Transactions of the Kansas Academy of Science, for, the responsibilities on his farm did not permit him to leave home very often. Ferdinand F. Crevecoeur was one of those old time naturalists who studied nature because he loved the out doors. He did not have the stimulation of frequent associations with fellow naturalists, but rather lived a lonely life. Most folks regarded him as peculiar and his insect collecting as trifling.

F. F. CREVECOEUR

The writer first heard of Mr. Crevecoeur in August, 1922, through a letter he wrote to the college. He had parted with his insect collection to Ottawa University, but had started another one. He was planning to prepare additions to the list of known Lepidoptera of Kansas. It was not until the fall of 1925 that we made a trip to Onaga and really made the acquaintance of this genius of the woods and fields. We were much impressed by his enthusiasm, his keen collecting ability, his interest in music, art, and the beauty of nature.

In the fall of 1927, the members of the Department of Entomology and their families motored to Onaga, taking a picnic dinner with them, to do honor to this little known naturalist. At that time we asked him for some facts about himself to use in a biographical sketch. The following account is quoted verbatim from his letter:

"My father, August Crevecoeur, was a native of the Province of Namur, Belgium. He, with his father and three brothers, came to Illinois in 1856. My mother, Dorothy Detman, came to America from Mecklinburg-Schwerin, Germany, about the same year as my father. They were married at Chicago, Illinois, in 1859. I was born June 23, 1862. My parents removed soon after to near Green Bay, Wisconsin. Later they came back to Illinois, locating at Clifton, where my grandfather had bought a quarter section of land.

"My father died when I was five years old. My mother and I went to live with one of my father's brothers, Ferdinand, at Chicago, the winter of 1869-70. The first of April my mother and I came to this locality where my mother married my father's oldest brother, Charles. This has been my home since, as my step-father had homesteaded eighty acres of land in 1869. He died in 1892 and my mother passed away in 1908. I have lived alone since.

"Coming to Kansas, just as vegetation was starting and all manner of life was feeling the effect of returning summer, I found much to interest me. The flowers, the fishes, the bugs, reptiles and animals all claimed much of my attention. But the names of very few could be learned as the older settlers had no names for the majority of wild life. Only once in a while could the name of some common bird or animal be learned, and I was just dying to learn the names of everything I ran across. I often sat by an ant's nest for hours to watch them at work. Reading in the Bible that the ant provided for the winter, I experimented in feeding them by catching grasshoppers and dismembering them which I placed near the ant's nest to see the ants carry the pieces down to their homes. But I was disappointed when on visiting the same nest the following day or two to find the ants had carried the harder portions of the hoppers out of their nests, the juicy parts having been devoured. The Biblical account did not seem true. As we were poor and the books I had access to were few, I did not have much to read from which to learn. Most of the neighbors were French and some had a few books in their homes. I must have been nine or ten years old when I started by myself to learn to read French and thus added to my list of books that I could borrow to read.

"About the year 1889, a copy of the Annual Report of the U. S. Department of Agriculture chanced to fall into my hands and this

opened a new era in my life. Here I learned many books on natural history and the sciences could be procured from the government and I was not slow in availing myself of the opportunity of procuring them. At this time I learned the Agricultural Department would cooperate in helping impart knowledge to those who wished, by offering to name speciments of birds, etc. I now commenced collecting all manner of wild life, including plants, which were sent in for identification.

"About this time I received quite a jolt, when a specimen of the brown thrasher was so named by the Department, the bird having been called the mocking bird by some of the people with whom I was in touch.

"Among the insects sent in was a new species of Lachnosterna, L. minor, a description of which came under the notice of Dr. W. Knaus. He wrote me for specimens, but I was sorry to tell him that the specimen sent to Washington was the only one I collected in more than twenty-five years. Dr. Knaus invited me to attend the annual meeting of the Kansas Academy of Science in Topeka in 1899, where I became a member of that body. At the meeting I made the acquaintance of Prof. B. B. Smyth, with whom I previously had some correspondence in regard to the names of plants. I soon had a correspondence acquaintance of a number of the prominent entomologists, including Snow, Wickham, Fall, Van Duzee, Aldrich, and others with whom I exchanged specimens of insects, or collected for them specimens in the orders in which they were the more interested. In 1917 I transferred my collection to Ottawa University, as it was considerable to care for the specimens I had and I felt they could take better care of it than I could. I could not resist the impulse of collecting and have since made a fair showing at restoring my working collection of insects."

Prof. L. C. Wooster gave a summary of Mr. Crevecoeur's collection, which went to Ottawa University, in his annual address (1906)[1]. The summary includes quite a range of plant and animal groups, comprising a total of 14,126 specimens and 6,502 species.

A hasty glance at Mr. Crevecoeur's restored insect collection revealed an uncanny ability for picking up rare and unusual forms. He pinned his insects in cigar boxes and kept them in lard cans (Crevecoeur, 1903). His labeling and spreading were carefully done, showing a deftness of hands many do not possess. He kept field notes on his speciments and could give a surprising amount of information about them. Being also a botanist, he recorded also the scientific names of the plants and ecological conditions in general.

1. Wooster, Lyman C. The Development of the Sciences in Kansas. Trans. Acad. Sci. Vol. 20, pp. 23-40, 1906.

He was a close student of the weather. He kept a daily record of climatic conditions, recording in particular the daily minimum temperatures during the winter and the maximum temperatures during the summer. His notes reveal also, weekly and monthly summaries of the weather, including particularly, rainfall and growing conditions for crops. His private papers reveal that for a number of years he recorded the exact time of sun rise. These observations were made from the south window upstairs on the east side of the house by the aid of a small spy glass.

He possessed a surveyors outfit including a transit and drawing materials. He mastered the elements of trigonometry and surveying alone with the aid of a few books and his encyclopedias. He was often called upon by members of his community to survey farms or plots, to lay out line fences, ditches, and cemetery plots. In about 1898 he prepared a map of Pottawatomie county by townships, placing all the farms, roads, creeks, villages, and other data included in such maps. It is still the official county map.

A certificate signed by Paul G. Redington and dated December 1, 1930, gratefully acknowledges 41 years of his faithful services "in reporting, for use in scientific deductions, the movements of North American Birds" for the Biological Survey of the U. S. Department of Agriculture. He was also a frequent correspondent of Dr. L. O. Howard of the Bureau of Entomology to whom he sent many specimens for identification and many interesting and valuable observations on insect life.

He took a leading part in the annual agricultural fair at Onaga. His knowledge of agriculture made him a valuable judge of exhibits and a source of information to farmers in his community.

He was a life member of the Kansas Academy of Science. This society gave him his most important personal contacts with those engaged in science and his medium of publicity for most of his scientific articles.

Mr. Crevecoeur's interest in insects is said to have begun when he was a small boy. The overflow from their watering trough resulted in a mud puddle which he noticed was being visited by insects. He saw that some were carrying away bits of mud, so he followed these insects to see what they did with it. This brought him to the nests of the mud dauber wasps which he watched at work. He then colored the mud and watched this colored mud appear in the nests. He applied different dyes to the mud on different days with the results that the nests of the wasps showed alternate bands of different colors. This interest led him to do extensive collecting in his immediate community and the many references in taxonomic literature to

Onaga, Kansas, in practically all cases, is the result of specimens collected by this energetic student.

His interest and keen observation of birds resulted in several discoveries. He first found the black-throated green warbler in Kansas, identification of which was verified by Doctor Snow, who reported the record.[2] He also reported a nest of the Pine Siskin near his home. This was said to be the farthest south of any nest recorded at that time. (Crevecoeur, 1922).

Being a batchelor, he has always done his own cooking, sewing, and housekeeping in addition to operating his farm and maintaining his other interests. This has made his life a very busy one. Mr. Crevecoeur suffered from ill health during the last four or five years. This prevented the continuance of some of his collecting and field observations.

The writer planned to go to Onaga on April 12, for renewing this acquaintance and to see the latest additions to his collections. He had written early in March that he was drawing up his will and wished to see a representative of the college before completing it. It was the intention to read this biography to him and have him correct any statements, if any were wrong. However, Mr. Crevecoeur died suddenly while harnassing a team of horses in his own barn, Tuesday, April 7, and was buried in the Onaga cemetery beside his parents on April 11. A fitting eulogy was spoken by Rev. Wright M. Horton. The federated church at Onaga was well filled with neighbors and friends from the community. Ottawa University was represented at the burial by Miss Meeker and Dr. Wilson; the State Grange by Mr. Foltz; and Kansas State College by Professor George A. Dean and the writer.

An unfinished and unsigned will was found after his death which indicated that his scientific library and insect collection was to be given to Kansas State, his encyclopedias and dictionaries to the local schools, and the remainder of his estate was to be used to build a community house at Onaga. Many persons knew that these were his intentions. However, the only copy so far found is not in legal form so the disposition of his property is uncertain. Two distant cousins living in Illinois constitute, so far as is now known, his nearest and only relatives.

Kansas State College purchased his collections and the larger part of his technical library at public sale on May 12, 1931. The insect collection consisted of 186 cigar boxes of pinned insects and unmounted duplicates of the smaller species put up in small cigarette-like rolls.

2. Snow, F. H. Notes for 1903 on the Birds of Kansas. Trans. Kans. Acad. of Sci. Vol. 19, pp. 261-268, 1904.

The specimens are all properly pinned and labeled. While most of the material was already in the collection of the department of Entomology, these specimens added the Onaga locality. The best additions were in the small forms. There was also a small collection of plants of about 50 specimens, a small box of shells and another of fossils.

His library was an unusual one. It was rich in literary works of merit, particularly of the old masters. The technical library consisted mostly of publication of the U. S. Department of Agriculture. It was particularly rich in entomology and geology.

Through the kindness of Mr. L. V. Dunn, the administrator, the college also obtained his scientific notes. Among them was an annual record of bird migrations for Onaga from 1904 to 1927, giving the time of arrival of each species, nesting dates, and date of departure. There was a long record of the flowering and fruiting dates of most of the wild plants about his home. He had also kept a weekly record of the price of farm produce, particularly farm live stock, from 1919 to 1931. There were interesting notes on moles, field mice, snakes, lizards, and other animals about his home. It is planned to have these notes edited by suitable specialists and the information they contain published to his credit.

Thus passed suddenly, a most unusual man. He was one of the state's few old time naturalists at the time of his death. His extraordinary industry is difficult to comprehend. He was drawn on in his studies by an insatiable desire to learn. He had few opportunities as the world counts them but this did not deter him. His accomplishments when viewed in the light of his opportunities, are very unusual. His life and work should always be a source of encouragement to young and old in their efforts to understand the ways of nature.

There is appended herewith a complete list of his technical or more important publications. He was a frequent contributor to the Onaga Republican beginning about 1899. A list of 56 subjects was found among his papers.

CREVECOEUR, F. F.

1901 **Origin of Life.** The Onaga Republican, Feb. 7 and 14.

1901-2 **Old Settlers' Tales.** Historical and Biographical Sketches of the Early Settlement and Settlers of Northeastern Pottawatomie and Southwestern Nemaha Counties, Kansas. Onaga Republican. (Also issued as booklet of 162 pp.).

1902 and 1906 (Several articles on the possibility of finding oil and gas near Onaga). In Onaga Republican, Feb. 20, 1902; Jan. 18, 1906; March 29, 1906.

1903 Some Entomological Notes: Ent News, Vol. 14, pp. 47-50.
1903 Some Entomological Notes: The Western Naturalist, Vol. I, No. 1, pp. 6-8.
1903 List of Fossil Plants Collected in the Vicinity of Onaga, Kansas: Trans. Kans. Acad. of Sci. Vol. 18, pp. 124-128. 1 plate.
1903 A New Species of Fish (Etheostoma arcus-celestis n. sp.). Trans. Kans. Acad. of Sci. Vol. 18, pp. 177-178.
1904 Some Variations Among Some Kansas Wild Flowers. Trans. Kans. Acad. of Sci. Vol. 19, pp. 205-208.
1904 Additions to the List of Hemipterous Fauna in Kansas. Trans. Kan. Acad. of Sci. Vol. 19, pp. 232-237.
1905 Additions to the List of Kansas Diptera. Trans. Kans. Acad. of Science. Vol. 20, pp. 90-96.
1908 A New Campostoma. Trans. Kans. Acad. of Sci. Vol. 21, pp. 155-157 (1907) 1908.
1922 A New Nesting Record for the Pine Siskin. Trans. Kans. Acad. of Sci. Vol. 30, p. 376.
1922—Additions to the List of Kansas Lepidoptera. Trans. Kans. Acad. of Sci. Vol. 30, pp. 377-385.
1922 Additions to the List of Kansas Hymenoptera. Trans. Kans. Acad. of Sci. Vol. 30, pp. 385-388.

GLACIAL STRIAE AND GROOVES IN KANSAS

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Glacial striae are the fine-cut lines or scratches made on rocks by the scouring effect of glaciers. When such scratches are deep or wide they are called glacial grooves. Glaciers act as huge files and by means of the partially imbedded rocks frozen in the ice or by boulders, gravel, sand and clay forced along between the base of the ice and the rock, the surface over which the glacier moves is striated or grooved. Scratches are not only produced on the rock surfaces over which the ice sheet advances, but also on the individual rocks which are partially imbedded in the ice or which are forced along between its base and the bed-rock.

Glacially marked bed-rock surfaces are of special interest to geologists for they indicate the direction of ice movement of a former glacier or ice sheet. In Kansas, only six localities are on record at the present time where such phenomena occur. Their general absence is considered by some as arguing for little glacial ice action in this state, a view not entertained by the writer. The absence or apparent absence of glacial striae and grooves in Kansas may be accounted for in a number of ways among which the following may be suggested: (1) much of the bed-rock in the glaciated portion of Kansas is shale, a rock not favorable for the preservation of glacial scratches or grooves; (2) certain limestones because of their peculiar nature are not suited for striation; (3) some of the glacial markings have undoubtedly disappeared due to the long period of exposure and weathering which has elapsed since the retreat of the ice sheet; (4) striae and grooves are concealed under heavy overburdens of drift and soil; and (5) detailed search for such phenomena has not been made.

Shale is a non-resistant rock. A glacier moving over a surface composed of such rock would tend to gouge out the shale in large masses and crumble it to fine particles. It follows, therefore, that striae or grooves, if formed, could not exist very long in shale. Also post-glacial weathering would soon obliterate any of these markings in the easily weathered shale. Limestones in general are well suited for striating and grooving, many of them showing beautifully ice-carved surfaces. Not all limestones, however, over which the ice advanced are glacially marked. Field observations in Brown and Doniphan counties show that many of the limestones exposed near deposits of drift are thin-bedded and are cut by numerous closely spaced joints. Because of these characteristics, the limestone is easily broken up into small blocks, scales or rock fragments, all of which could be plucked out easily and removed by an advancing ice

sheet. In order that a bed-rock surface may be glacially marked the bed-rock should be solid or firm. Other limestones were observed which undoubtedly must have at one time borne striae or grooves, but from which all traces of glacial erosion have since been removed. It is to be remembered that Kansas was invaded by the next to the oldest ice sheet and that since the uncovering of the glaciated limestone surface on the retreat of the ice and subsequent erosion sufficent time has elapsed for the complete removal of the glacial markings due to the ordinary processes of weathering. Only at those places where the glaciated surface has recently been uncovered and exposed are striae or grooves likely to occur. Undoubtedly, many ice carved surfaces are still hidden under accumulations of drift or soil,

County	Location				Direction	Discovered		Reference Number
	Township	Range	Section	General		In	By	
Nemaha	T 3 S	R 12 E	17	2 mi. SW. of Seneca	S 24° 36' W S 21° 08' W	1892	Wooster	8
Leavenworth	T 12 S	R 22 E		2 mi. E. of Lenape	S 21° E	1916*	Todd	7
Wyandotte	T 11 S	R 25 E	Kansas City	Near cor. 25th. and Sandusky Sts.	S 16° W S 24° W	1916*	"	7, 4
Wyandotte	T 10 S	R 25 E	Kansas City	NE of Quindaro Park	S 16° W	1916*	"	7
Wyandotte	T 11 S	R 23 E		Near Loring	S 20° E	1916*	Darton	2
Douglas	T 13 S	R 21 E		East of Eudora	Not recorded	1910-16*	Twenhofel	5
Brown	T 2 S	R 18 E	NE 1/4, 32	1 mi.N.of Robinson	S 22° E	1930	Schoewe	6
Brown	T 2 S	R 18 E	SW 1/4, 33	1 mi.N.of Robinson	S 23° E	1930	"	6
Doniphan	T 2 S	R 21 E	SE 1/4, 34	3 mi. N. and 2 mi. W. of Blair	S 10° E S 2° and 9° W	1930	"	6
Doniphan	T 3 S	R 21 E	NE 1/4, 11	1½ mi. N. and 1½ mi. W. of Blair	S 22° to 25½° E S 4° to 6° E	1930	"	6
Leavenworth	T 11 S	R 22 E	NW cor. 13	1 mi. W. of Loring	S 10° E S 34° to 42° E	1930	Jewett and Newell	3
Wyandotte	T 10 S	R 25 E	NW cor. 30	NE. of Welborne	S 5° E	1930	"	3
Wyandotte	T 11 S	R 23 E	SW cor. 30	1 mi. W. of Bonner Springs	Not recorded	1930		3
Wyandotte	T 11 S	R 24 E	SW cor. 12	Serridge interurban stop	Not recorded	1930	"	3
						*Approximate date		

Table showing data of glacial striae in Kansas

eventually to be exposed after prolonged weathering and erosion of the overlying mantle of drift or due to the activity of man. The general absence of glaciated rock surfaces in Kansas may partially be accounted for by the lack of detailed search for them. Detailed geologic mapping carried on by parties of the University of Kansas Geological Survey during the last year in Leavenworth, Wyandotte, Brown and Doniphan counties has resulted in the discovery of eight new localities where glacial scorings occur. These new localities, including all others known in Kansas together with data on the direction of striae, date of discovery, authority and reference to the literature are given in the table showing data of glacial striae in Kansas.

An inspection of the table showing data of glacial striae in Kansas shows that the striae, on the basis of their direction, may be grouped into two sets, one tending approximately S 20°W, the other S 20°E. Two sets of striae do not necessarily have any significant importance. Where, however, they are closely associated or where cross-striae occur two directions of ice movement are indicated. These two directions of ice movement may be interpreted as having been produced either by (1) two distinct ice sheets, (2) two advances of the same ice sheet, (3) advances of two separate lobes of one and the same ice sheet, and (4) by the minor cross-movements that affected the marginal portion of a glacier. As shown by Chamberlain (1888) cross-striation may be produced by a single ice sheet by (1) changes of glacial movement during a symmetrical retreat and by change of movement due to (2) varying topographic influence, producing an unsymmetrical retreat, (3) inequalities of supply, (4) varying rates of ablation, (5) glacial drainage, (6) the seasons, (7) solar action, (8) climatic periods, (9) inequalities of debris covering and (10) possible movements of the earth's crust. Sufficient data is at the present time not on hand to warrant favoring any one of the possible interpretations.

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NOTE ON THREE-ELECTRODE GAP AS APPLIED TO INSTANTANEOUS PHOTOGRAPHY

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In 1926, Wynn-Williams[1] investigated the theory of the "three-point gap", which phenomenon had been known and utilized for some time but until his investigation was not understood theoretically.

The phenomenon is as follows: Two electrodes, A and B, are adjusted so that a spark will pass regularly, then by increasing the distance between them by a very small amount, the discharge will cease. But if a third electrode, C, is brought within a few centimeters of the gap as shown in Fig. 1, the discharge will again take place, regularly as before, while a small spark will pass from the third electrode to the neighboring main electrode, or seemingly into the gap space. This tiny spark is called the "pilot", or "teaser", or "trigger" spark. The effect is more pronounced if C is connected to one of the main electrodes as in Fig. 2. Usually, the distance between A and C must be greater than that between A and B or the discharge will take place between A and C.

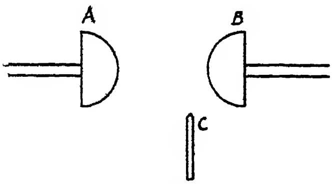

Fig. 1

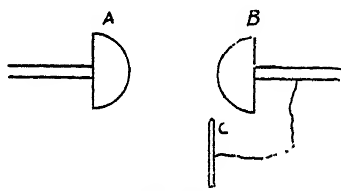

Fig. 2.

Two explanations of the phenomenon have been suggested: First, ions are produced by the small pilot spark, which traveling into the main gap facilitate the passage of the main spark; Second, the pilot spark sets up oscillations in the main electrodes, which serve to cause the peak voltage to rise periodically above the critical sparking voltage, and so cause the main spark to pass. Neither explanation was found correct.

In summarizing, Wynn-Williams infers that the three-point effect is caused by the ionization of the gas in the gap space by a radiation, believed to be a form of entladungstrahlen, emitted by the pilot discharge. Disturbances of the field, passage of ions into the gap space, or photo-electric effects produced by radiation or by ultra-violet light, while possibly assisting in, are not essential for the production of the three-point effect.

Since the purpose of this paper is a brief on the application of the three-electrode effect to instantaneous photography, it might not be

amiss to refer to an analogous method used by Foley[2] in obtaining this same result. In his arrangement for photographing sound waves, he inserts two glass plates between the terminals of his induction machine whenever he cares to set off a discharge through the camera. By so doing, the glass plate upon entering the intense electric field increases the field strength of the air spaces between it and the neighboring electrodes to the extent that a disruptive discharge takes place. Thus, "the presence of a layer of dielectric of large inductivity throws an excess of stress on a layer of a dielectric of small inductivity."[3]

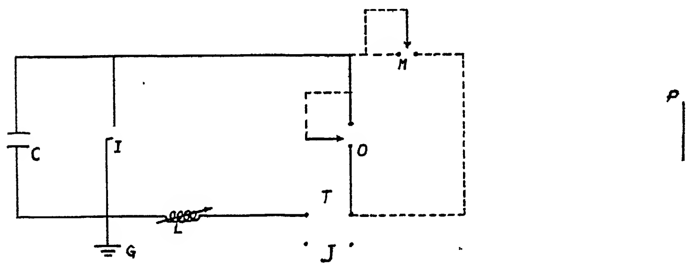

Fig. 3. Three-point gap located in camera.

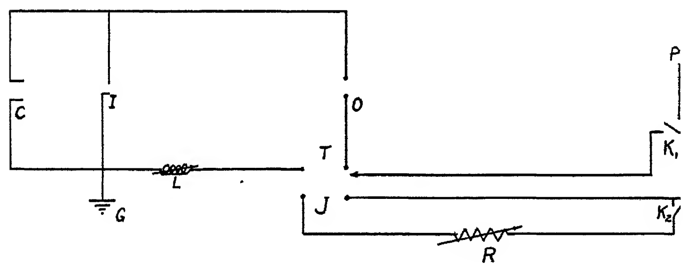

Fig. 4. Three-point gap applied to static machine terminals

Figs. 3 and 4 show various dispositions of apparatus with which the writer experimented. The only essential difference in Fig. 3 from the apparatus used by Foley is the insertion of the inductance coil and the micrometer side gap.

In these figures, C was a condenser consisting of seven two-gallon Leyden jars of approximately 0.00045 mf each. The inductance, L, was a solenoid 20 cm. long and 8.5 cm. in diameter consisting of 20 turns of single layer copper strip. K_1 and K_2 are switches which were so connected that they could be reached from the plate end of the

camera. The gaps, I, O, and M, are, respectively, the illuminating gap, the object gap, and the side or micrometer gap. The arrow represents the third electrode, a steel needle mounted in a glass jar.

Two different resistances, R, were tried as indicated in Fig. 4: First, a resistance made by drawing a line of India ink on a glass plate; Second, a resistance consisting of a V-shaped glass tube 32 cms. long filled with distilled water. Small German silver wires which were adjustable comprised the electrodes. The latter contrivance produced the most satisfactory results.

The arrangement of apparatus in Fig. 3 yielded no success with respect to a three-electrode control. This, however, was preliminary to later work.

Fig 4 represents two different methods of control: First by keeping K_2 open and using K_1; Second, by closing K_2 and using K_1. In the first case, K_1 was kept open until it was desired to produce a discharge through the camera. Then by closing K_1, the three-point gap would function and a discharge followed. The terminals, J, of the static machine were so adjusted that the discharge would take place between them except when K_1 was closed, the closing of which produced the three-point effect in T-J causing a relative decrement of resistance between these points as compared with that across J.

In the second case, K_2 was kept closed during the entire experiment. The distance between the terminals, J. was so great that the spark never passed between them. The resistance, R, connected across the terminals of the static machine was made as large as feasible and yet not so great as to cause a spark to pass between T and J. Then by closing K_1, the resistance of the gap, T-J, would be diminished causing a spark to pass between them. Opening K_1 prevented a further discharge across T-J. This method seemed to be improved when a micrometer gap was connected in parallel with the object gap.

The first method was the most successful, every exposure producing a good photograph. Although the second method was successful, occasionally a poor photograph would appear. In the latter method much more care and precision was required in adjusting the various gaps and the resistance.

The writer is continuing this investigation by the use of a 25,000 volt transformer as the generator of electric charge instead of the static machine employed in the earlier work reported above.

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IDENTIFICATION OF CHIRONOMID EGG MASSES II

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The present paper is merely a report of activity in the continuous observations of the author on the identification of the egg masses of the family Chironomidae. This paper is the outgrowth of a request from the Committee on Hydrobiology of the National Research Council and was read by title last December on that program.

Incidentally, this investigation on identification brings up a new record now and then. The species Chironomus lobiferus Say, Chironomus viridicollis Van der Wulp, and Chironomus flavus Johannsen have not been reported previously for Kansas. The egg mass of Ch. viridicollis is reported as observed but the findings do not agree with ours but can be explained. (1).

The egg masses are obtained in two ways. First: they may be gathered from twigs, leaves, stones or other debris on or near the water's edge in pools and streams, in which case the egg masses are carefully cleaned to remove visitors which would lead to incorrect classification. The egg masses are then photographed submerged in water and then placed in proper conditions for rearing; the larvae, pupae and adults reared and classified. In the second method, the females are captured by placing a test tube over them as they rest (one to a tube). A centimeter or two of water is placed in each tube which are then lightly plugged with cotton and set at a slant on a support in normal light. Eggs will be laid in twenty-four to forty-eight hours and these are placed in water, photographed and handled as described above. Frequently eggs obtained in this way are sterile but by obtaining a number of females, taken in the morning or early afternoon, some masses will be fertile.

The accompanying plates show the pictures of egg masses from which larvae were reared and in some cases pupae and adults.

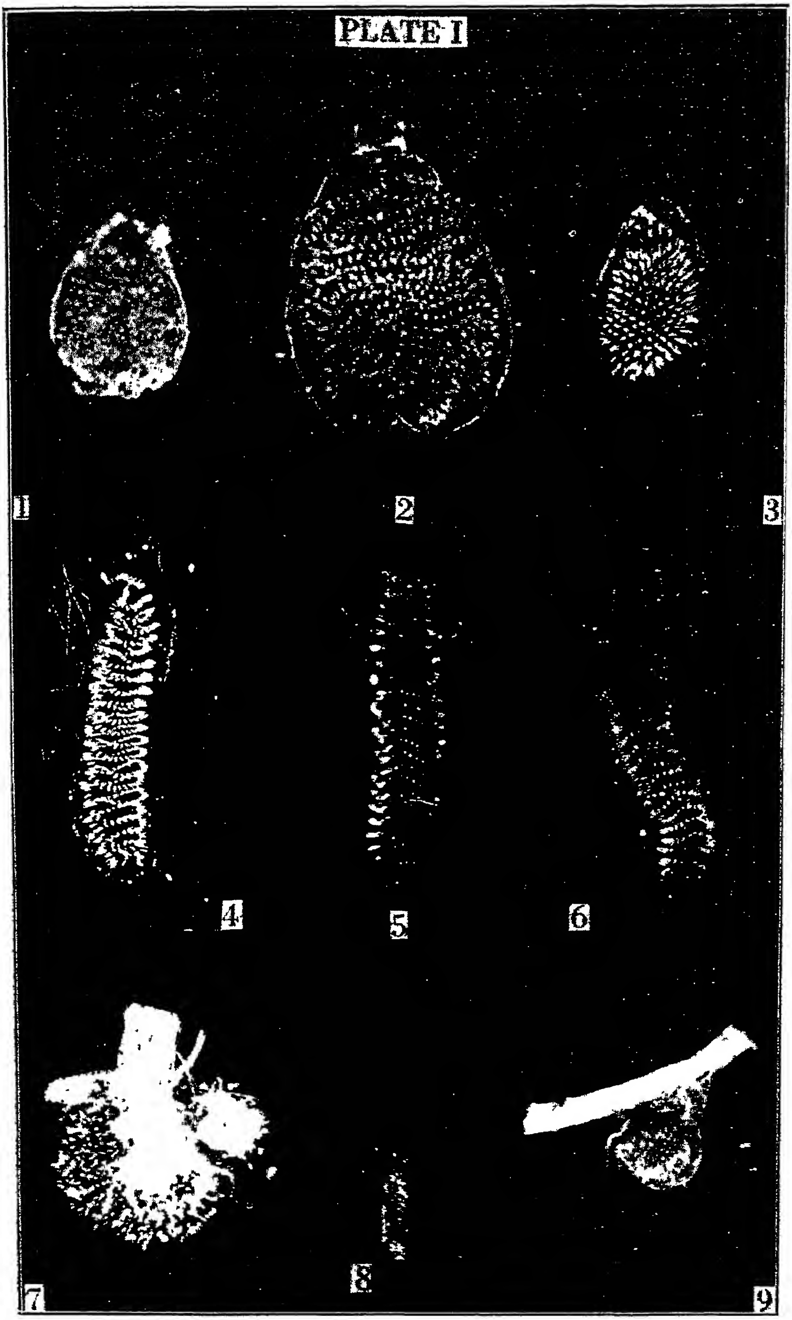
Chironomus decorus Johannsen

Plate I, Fig. 1, Fig. 2., and Fig. 3 are of Chironomus decorus Johannsen, to show a variation of size within a species. The egg mass in Fig. 1 measured 7 mm.x4 mm. and the eggs were white; in Fig. 2 the mass measured 12 mm.x7 mm. with eggs a pale tan; and in Fig 3 the mass measuered 5 mm.x3 mm. with pale tan eggs. The difference in color of egg was probably due to age as mass No. 2 and No. 3 hatched earlier than No. 1 which also turned tan before hatching. This form was taken at Pratt, Kansas, June 29, 1930. Plate III, Figs. 6-7-8-9-10, show some structure sketches on this species.

PLATE 1

Fig. 1. Chironomus decorus
Fig. 2. Chironomus decorus
Fig. 3. Chironomus decorus
Fig. 4. Chironomus lobiferus
Fig. 5. Chironomus lobiferus
Fig. 6. Chironomus lobiferus
Fig. 7. Chironomus lobiferus
Fig. 8. Chironomus flavus
Fig. 9. Chironomus viridicollis

PLATE I



Chironomus lobiferus Say

Plate I, Figs. 4, 5, and 6, are masses of Chironomus lobiferus. The mass shown in Fig. 4 measured 9 mm.x1.5 mm.; in Fig. 5 it measured 9 mm.x2 mm., and in Fig 6 it measured 14 mm.x2.5 mm. This form was taken at Pratt, Kansas, August 31, 1930.

Plate II, Figs. 1, 2, and 4 are likewise Ch. lobiferus taken at Oak Park, Wichita, Kansas, on June 27, 1930. No. 1 measured 7 mm.x2 mm., and No. 2 measures 9 mm.x2.5 mm. These photographs were made with a white background whereas those of Plate 1 had a black background. No. 4 lies arcuate because both ends are attached which is not normal. Plate III, Figs. 11-15 show structure sketches for this species.

One ecological obervation was made on this species. The larvae make tubes of silt and soil on chara and others were found in the inner meshes of the petioles of the leaves of the water lily.

Chironomus flavus Johannsen

Plate I, Fig 8 shows the tiny white egg mass of this species which measured 2.5 mm.x0.75 mm. The mass was obtained by the second method and was laid by a female captured at Pratt, Kansas, August 31, 1930. The eggs were laid September 1st and hatched the 2nd. We had a female adult emerge September 26. This specimen was captured and placed in a test tube where she laid an egg mass (sterile of course). We have the female and the egg mass preserved.

Chironomus viridicollis Van Der Wulp

Plate I, Fig. 9 shows an egg mass collected from a lily pad at Pratt, Kansas, July 29, 1930. It measures 2.5 mm. in diameter, is spherical and the eggs are practically transparent. Plate III, Figs. 1-5 show structure sketches of this species. Malloch (1) reports an egg mass laid by a female of this species on the edge of an aquarium after the female had been rescued from drowning a number of times. The gelatinous matrix of the mass was elongate but the eggs were clustered in one end. This elongation could have been the result of the rescuing as the mass would have clung to the surface tension and have been stretched out.

These observations will be checked during the coming season and errors corrected or results confirmed at the next meeting of the Academy.

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PLATE II

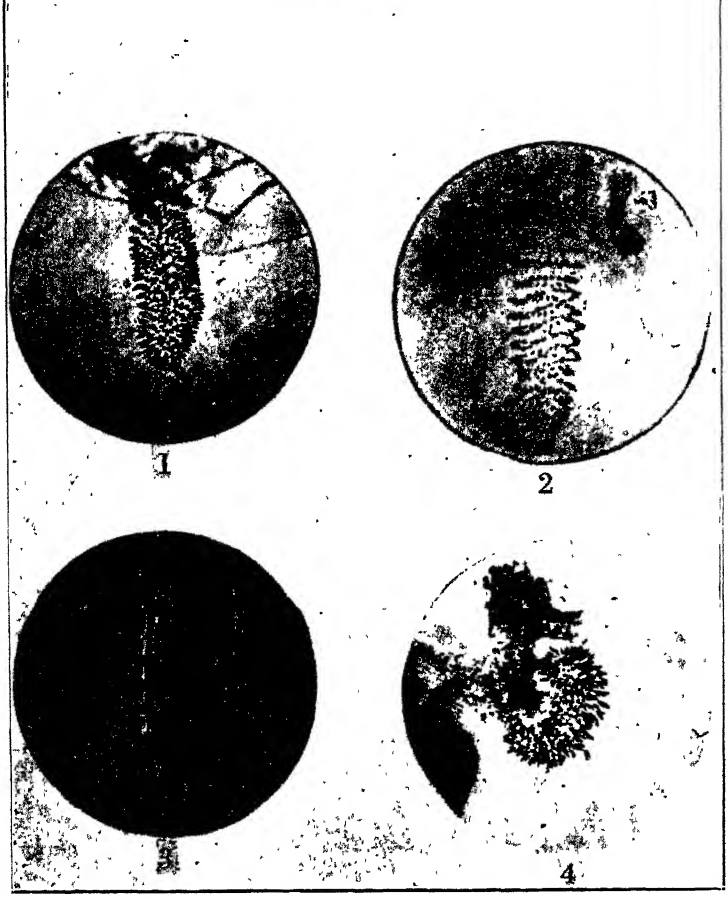

Fig. 1. Chironomus lobiferus
Fig. 2. Chironomus lobiferus
Fig. 3. Chironomid egg ready to hatch
Fig. 4. Chironomus lobiferus

PLATE III

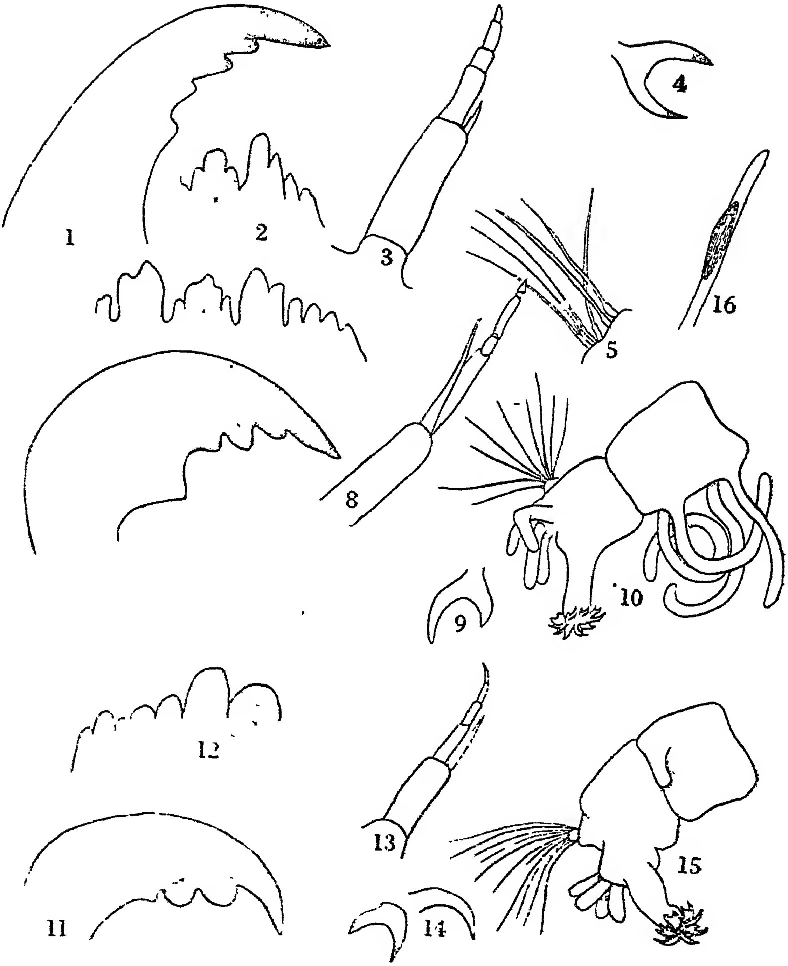

PLATE III

Fig. 1. Mandible of Chironomus viridicollis
Fig. 2. Labial ridge of Chironomus viridicollis
Fig. 3. Antenna of Chironomus viridicollis
Fig. 4. Claw of posterior legs of Chironomus viridicollis
Fig. 5. Hairs on elevation of twelfth segment of Chironomus viridicollis.
Fig. 6. Mandible of Chironomus decorus
Fig. 7. Labial ridge of Chironomus decorus
Fig. 8. Antenna of Chironomus decorus
Fig. 9. Claw of posterior leg of Chironomus decorus
Fig. 10. Eleventh and twelfth segments of Chironomus decorus.
Fig. 11. Mandible of Chironomus lobiferus
Fig. 12. Labial ridge of Chironomus lobiferus
Fig. 13. Antenna of Chironomus lobiferus
Fig. 14. Claws of posterior legs of Chironomus lobiferus
Fig. 15. Eleventh and twelfth segments of Chironomus lobiferus

P-PHENETIDINE AND P-ANISIDINE AS OXIDATION INDICATORS

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The long search of analytical chemists for a reversible oxidation indicator which could be added directly to the solution being titrated culminated in 1924 in the discovery by Knop[1] that the two substances diphenylamine and diphenylbenzidine react with traces of certain oxidizing agents to form a deep blue or violet holoquinoid. Because of the convenience and reliablility of these new indicators, the use in bichromate titrations of potasssium ferricyanide on a spot-plate has now been abandoned in most laboratories. However, under certain conditions which are not yet well-defined, diphenylamine and diphenylbenzidine yield on oxidation, not the blue or violet holoquinoid, but a green meriquinoid, which is indistinguishable in solution from the green chromic chloride formed by the reduction of the standard solution of potassium bichromate. While Kolthoff and Sarver[2] sought to establish the conditions which assure the formation of the blue rather than the green quinoid from diphenylamine or diphenylbenzidine, other investigators continued the search for new oxidation indicators.

In 1930 Szebelledy[3] worked out a bichromate method in which p-phenetidine serves as an inside indicator. When diphenylamine is used for this purpose it is customary to add a 1:1 solution of phosphoric and sulfuric acids to the ferrous solution in order to bind the ferric ions and thus prevent the solution from becoming too highly colored. Under these conditions the iron solution changes from bluish green to blue upon addition of the first drop of excess bichromate solution. Szebelledy found, however, that if ammonium fluoride is used in place of the phosphoric acid-sulfuric acid mixture and p-phenetidine in place of diphenylamine, the ferric ions become bound so effectively that the iron solution remains yellowish green instead of bluish green until the end-point has been reached. It then acquires the permanent blue or violet color caused by the oxidation of the p-phenetidine.

In the present research ferrous ammonium sulfate of known iron content was analysed by the methods of Knop and of Szebelledy in order to compare the value obtained with the two indicators diphenylamine and p-phenetidine; and in accordance with a suggestion made by Dr. F. B. Dains, p-anisidine was also tested as an oxidation indicator.

The results obtained by the Knop method, using diphenylamine and the phosphoric acid-sulfuric acid mixture, are shown in Table Ia.

TABLE Ia

BICHROMATE METHOD WITH DIPHENYLAMINE INDICATOR

TITRATION OF MOHR'S SALT WITHOUT PREVIOUS REDUCTION

REMARKS	WT. OF SAMPLE	CC. $K_2Cr_2O_7$	Fe VALUE OF $K_2Cr_2O_7$ SOLUTION	% Fe FOUND
H_3PO_4 and H_2SO_4	1.5006	37.88	.005630	14.21
" " "	1.5078	37.80	"	14.12
" " "	1.5052	37.57	.005697	14.22
" " "	1.5032	37.41	.005694	14.18
" " "	1.5009	37.27	"	14.14
" " "	1.5098	37.43	"	14.11
H_3PO_4, H_2SO_4 and $NaHCO_3$	1.5073	37.46	.005697	14.17
	1.5092	37.48	"	14.16
			Mean	14.16
NH_4F and $NaHCO_3$ Poor end-points and poor agreement.	1.5032	37.77	.005630	14.15
	1.5072	38.18	"	14.27
	1.5023	Could not be titrated		......

TITRATION OF MOHR'S SALT AFTER REDUCTION WITH STANNOUS CHLORIDE

REMARKS	WT. OF SAMPLE	CC. $K_2Cr_2O_7$	Fe VALUE OF $K_2Cr_2O_7$ SOLUTION	% Fe FOUND
H_3PO_4 and H_2SO_4	1.5030	37.45	.005697	14.20
" " "	1.5017	37.23	"	14.12
" " "	1.5033	37.49	"	14.22
" " "	1.5042	37.48	"	14.20
			Mean	14.19

TABLE I b

GRAVIMETRIC DETERMINATION OF THE FE IN THE MOHR'S SALT

WEIGHT OF SAMPLES	WEIGHT OF Fe_2O_3	% Fe FOUND
2.1260	0.4319	14.21
2.2097	0.4486	14.20

VOLUMETRIC DETERMINATION

WT. OF SAMPLES	CC. $KMnO_4$	Fe VALUE OF $KMnO_4$ STANDARDIZED AGAINST $Na_2C_2O_4$	%Fe FOUND
1.5026	27.76	.007690	14.21
1.5098	27.91	"	14.21

The iron content of the Mohr's salt as determined gravimetrically is 14.21% as shown in Table Ib, whereas the average of the results obtained with diphenylamine is 14.16% when salt was titrated without previous reduction, and 14.19% when titrated after reduction with stannous chloride in the usual manner. When this indicator is used in the bichromate method, ammonium fluoride cannot be used successfully for binding ferric ions.

The results obtained by the Szebelledy method, using ammonium fluoride and a freshly-filtered 1% solution of p-phenetidine, are shown

in Table II a. The average value found for iron by this method was 14.11%. When an old, discolored solution of p-phenetidine was used, however the results were much too low, and averaged 13.78%. These low results are shown in Table II b.

TABLE II a

BICHROMATE METHOD WITH PARAPHENETIDINE INDICATOR

TITRATION OF MOHR'S SALT WITHOUT PREVIOUS REDUCTION

REMARKS	WT. OF SAMPLE	CC. $K_2Cr_2O_7$	Fe VALUE OF $K_2Cr_2O_7$ SOLUTION	% Fe FOUND
NH_4F and $NaHCO_3$	1.5038	37.69	.005630	14.11
" " "	1.5005	37.65	"	14.13
" " "	1.5010	37.10	.005697	14.09
" " "	1.5006	37.20	"	14.12
" " "	1.5032	37.33	"	14.15
" " "	1.5020	37.38	"	14.18
" " "	1.5086	37.30	.005694	14.07
" " "	1.5034	36.95	"	14.00
			Mean	14.11

TABLE II b

NH_4F and $NaHCO_3$	1.5016	36.45	.005697	13.83
Indicator partly	1.5092	36.71	"	13.86
oxidized and dis-	1.5000	36.30	.005694	13.78
colored.	1.5047	36.10	"	13.66
			Mean	13.78

TABLE III

BICHROMATE METHOD WITH PARAANISIDINE INDICATOR

TITRATION OF MOHR'S SALT WITHOUT PREVIOUS REDUCTION

REMARKS	WT. OF SAMPLE	CC. $K_2Cr_2O_7$	Fe VALUE OF $K_2Cr_2O_7$ SOLUTION	% Fe FOUND
NH_4F and $NaHCO_3$	1.5062	37.34	.005697	14.13
" " "	1.5027	37.38	.005696	14.16
" " "	1.5012	37.25	"	14.14
" " "	1.5026	37.34	"	14.15
" " "	1.5101	37.48	"	14.14
" " "	1.5014	36.77	"	13.95
" "	1.5074	37.06	"	14.00
			Mean	14.10
H_3PO_4 and H_2SO_4	1.5019	Cannot be titrated		....

p-Anisidine proved to be as good an indicator as p-phenetidine and to give an even more brilliant color. Results with this indicator are given in Table III. p-Anisidine, like p-phenetidine, should not be allowed to become partially oxidized and discolored before use. Phosphoric acid cannot be used for binding the ferric ions when either of these indicators is to be used.

In the well-known Zimmermann-Reinhardt method for iron, in which a so-called "preventive solution" containing manganous sulfate, phosphoric acid and sulfuric acid is added to the reduced iron solution before titration in order to prevent both the oxidation of hydrochloric acid by the standard solution of potassium permanganate and the yellow color due to ferric chloride, the end-point is transitory. In 1924 W. W. Scott[4] found that when a drop or two of diphenylamine is added to the iron solution before titration, the purple color produced by the excess drop of potassium permanganate is much more permanent than the pink produced by the permanganate alone.

In the present research three modifications of the Zimmermann-Reinhardt method were attempted: (1) the substitution of ammonium fluoride in place of the phosphoric acid-sulfuric acid mixture to bind the ferric ions, (2) the use of a suitable oxidation indicator to give a permanent color at the end-point, and (3) the incorporation in a single preventive solution of the ammonium fluoride, the manganous sulfate and the mercuric chloride used to oxidize the excess drop of stannous chloride used for reducing the iron. This preventive solution was made by adding 50 grams of $MnSO_4$, 4 H_2O and 20 grams of ammonium fluoride to 300 cc. of a saturated solution of mercuric chloride and diluting with water to 400 cc. Since this does not give a clear solution, the bottle is always shaken before removal of the 40cc. portion to be added to each of the reduced iron solutions immediately before titration.

TABLE IV

PERMANGANATE METHOD WITH PREVENTIVE SOLUTION

TITRATION OF MOHR'S SALT AFTER REDUCTION WITH STANNOUS CHLORIDE

REMARKS	WT. OF SAMPLE	CC. $KMnO_4$	Fe VALUE OF $KMnO_4$ SOLUTION	% Fe FOUND
Preventive soln.	1.5060	27.83	.007690	14.21
contains 300 cc.	1.5025	27.71	"	14.17
satd. $HgCl_2$, 50 gms.	1.5072	27.64	"	14.10
$MnSO_4.4H_2O$, 20 gms.	1.5022	27.49	"	14.07
NH_4F made up to 400	1.5102	27.91	"	14.21
cc. 40 cc. of this	1.5036	27.70	"	14.16
soln. and 1 or 2 cc.	1.5076	27.79	"	14.17
p-phenetidine added	1.5015	27.61	-	14.14
to each Fe sample	1.5033	27.71		14.17
after reduction.	1.5056	27.79		14.19
	1.5010	27.80		14.24
	1.5006	27.90		14.29
	1.5100	27.86		14.19
	1.5036	27.67		14.15
	1.5008	27.61		14.15
			Mean	14.17
Same preventive	1.5035	30.23	.007079	14.24
soln., but with	1.5013	30.30	"	14.29
p-anisidine in	1.5021	30.17	"	14.22
place of p-phenet-			Mean	14.25
idine.				

From Table IV it will be seen that the average value found for the iron in Mohr's salt when p-phenetidine was used was 14.17%, whereas the average value obtained with p-anisidine was 14.25%. The agreement, however, is unsatisfactory.

TABLE V a

PERMANGANATE METHOD WITH PREVENTIVE SOLUTION

TITRATION OF MOHR'S SALT AFTER REDUCTION WITH STANNOUS CHLORIDE

	WT. OF SAMPLE	CC. $KMnO_4$	Fe VALUE	% Fe FOUND
Same preventive soln. as in Table IV. No indicator except $KMnO_4$.	1.5010	30.24	.007079	14.26
	1.5055	30.18	"	14.20
	1.5040	30.25	"	14.24
	1.5011	30.12	"	14.21
	1.5017	30.19	"	14.20
	1.5047	30.18	"	14.20
Same preventive soln. and 2 drops diphenylamine.	1.5000	30.07	"	14.19
	1.5026	30.17	"	14.22
Same preventive soln. and 5 drops diphenylbenzidine.	1.5010	30.14	"	14.22
	1.5020	30.19	"	14.23
			Mean	14.22

TABLE V b

PERMANGANATE METHOD WITH PREVENTIVE SOLUTION

TITRATION OF SIBLEY IRON ORE #27 AFTER REDUCTION WITH STANNOUS CHLORIDE

BUREAU OF STANDARDS VALUE = 69.2% Fe

REMARKS	WT. OF SAMPLE	CC. $KMnO_4$	Fe VALUE	% Fe FOUND
Same preventive soln. as in Table IV. 2 drops 1% diphenylamine. Insoluble residue fused with $K_2S_2O_7$.	.4086	39.88	.007079	69.10
	.4010	39.20	"	69.22
	.4037	39.45	"	69.19
	.4038	39.51	"	69.29
	.4019	39.29	"	69.21
			Mean	69.20

It was found, however, that much better agreement can be obtained by relying solely on the permanganate itself or by using diphenylamine or diphenylbenzidine to make the color more lasting than by using either p-phenetidine or p-anisidine. The results shown in Table V a average 14.22% Fe. The method also yielded correct results with a Bureau of Standards ore as shown in Table V b.

SUMMARY

1. When ammonium fluoride is used for binding the ferric ions, p-phenetidine and p-anisidine may be used as inside indicators for titrating iron with a standard solution of potassium bichromate, but they are less satisfactory as indicators in permanganate titrations.

2. These indicators must not be allowed to become partially oxidized before use.

3. Solutions of diphenylamine are more permanent than those of p-phenetidine or p-anisidine.

4. A modification of the Zimmermann-Reinhardt method for iron is proposed in which a single preventive solution containing mercuric chloride, manganous sulfate and ammonium fluoride is added to the ferrous solution immediately after the iron has been reduced with stannous chloride. A 1% solution of diphenylamine or diphenylbenzidine may be used if desired to give a more lasting color at the end-point.

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ON THE PREPARATION OF CHEMICALLY STABLE AND BACTERIOLOGICALLY EFFICIENT HYPOCHLORITE SOLUTIONS

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Chemically stable and bacteriologically efficient hypochlorite solutions may be prepared by passing chlorine gas into a solution of sodium hydroxide of suitable strength. The desired end-point can be determined either from the alkalinity or from the oxidizing power of the solution. To check the former in the presence of an indicator, a convenient volume of the solution is taken, an excess of potassium iodide added followed by sufficient thiosulphate to clear the iodine, the indicator added and the alkalinity titrated with standard acid. The oxidizing power is determined by adding to a measured portion of the sample an excess of potassium iodide, acidifying with acetic acid, and titrating the liberated iodine with standard thiosulphate.

The effectiveness of the product as a bactericidal agent may be judged from the following data. For the tests bacterial counts were made on innoculated water samples preceding and following treatment with the hypochlorite solution, one cubic centimeter samples being plated in nutrient agar. The count given in each case is the average from two plates.

In the case of sample "A" three dilutions of hypochlorite and contaminated water were made. These were permitted to stand two minutes before plating. Sample "B" consisted of water inoculated with sour milk and stale broth. In this case the time interval was varied. Sample "C" consisted of a sample of river water. This test involved variation in time of exposure and in dilution.

Table 2 shows the results of a comparative test made with a similar hypochlorite solution purchased on the market. Table 3 contains the data relative to the effect of hydrogen ion concentration on the efficiency of the hypochlorite solution.

TABLE 1.

SAMPLE A

	Controls	Untreated Sample	Dilutions 1-250	Dilutions 1-500	Dilutions 1-1000	Time
Counts	0	72,000	32	60	118	2 minutes

SAMPLE B

	Controls	Untreated Sample	Time in Minutes Two	Time in Minutes Five	Time in Minutes Ten	Dilution
Counts	0	640,000	165	57	86	1-250

SAMPLE C

	Controls	Untreated Sample	Dilutions 1-250	1-500	1-1000	Time
Counts	0	120,000	90	290	2300	2 minutes
Counts	0	120,000	150	250	2400	5 minutes

TABLE 2.

Comparative Tests with Commercial Product.

	Controls	Untreated Sample	Commercial Product	Authors Product	Dilution 1-250
Counts,	0	6,300	158	165	--------

TABLE 3

Hydrogen Ion Concentration and Effectiveness of the Hypochlorite Solution.

Initial reaction of the hypochlorite solution, tenth normal alkaline.

Bacterial Suspension	Hypo chlorite	Reagent Added 0.1 normal Base	Acid	Reaction of solution	Counts per cc.
cc	cc	cc	cc		
1	0	0	0	--------	600,000
199	0	3	0	alkaline	300,000
199	1	3	0	alkaline	108
199	1	2	0	alkaline	88
199	1	1	0	alkaline	120
199	1	0.5	0	alkaline	144
199	1	0	0	alkaline	100
199	1	0	0.5	alkaline	180
199	1	0	1	neutral	8
199	1	0	2	acid	150
199	1	0	3	acid	3

Hypochlorite, one part in two hundred and fifty, corresponded to a solution containing four hundredths of a part available chlorine in two hundred fifty, or to one part in six thousand two hundred fifty. The commercial sample referred to in Table 2, supplied a similar concentration.

The minimum time of exposure of two minutes in these experiments appears to be as effective as longer periods.

Dilutions of one to one thousand seem to be nearly as effective as those of one to two hundred and fifty.

The reaction of the hypochlorite within the limits of alkalinity and acidity studied seems to matter little.

VOLCANIC ASH IN NORTON COUNTY, KANSAS

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Volcanic ash is the fine dust-like material formed by the violent eruption of volcanoes, most of the particles being less than 0.1 mm. in diameter. The ash, as a rule, consists of angular fragments of rock-glass and small amounts of rock-forming minerals, usually feldspar. Its color varies from white to bluish-gray. Volcanic ash is known as silica in most localities in which it is mined and as pumicite by many companies that are using ash in their products.

Although most of Kansas is hundreds of miles from the site of any of the volcanic eruptions that have occurred during recent geologic time, the entire state is well within the area that was showered by the rock powder resulting from those disturbances. The ash was carried into Kansas by the wind and was deposited both on the land surface and in the small water bodies that existed here at that time. The deposits formed on land show cross-bedding, rapid variations in thickness, nonpersistent strata, and other typical eolian features; whereas the deposits formed in the water bodies have uniform horizontal bedding and persistent strata. Because of fortunate geologic conditions large quantities of the ash have been preserved and more volcanic ash is now mined in Kansas than in any other state in the Union. A map showing the general distribution of volcanic ash within the state is given by Landes[1] in his paper on the "Volcanic Ash Resources of Kansas". However, this map does not show all of the many individual occurences in each locality.

The volcanic ash deposits of the state were formed during two different geologic periods. The deposits in a few areas, of which Norton county is one, were formed during the later part of the Tertiary. They form a part of the Ogallala formation which covers the High Plains of western Kansas and adjacent states. The younger deposits, to which group most of those in Kansas belong, were formed during Pleistocene time. They are covered only by soil or recent material. From a study of the sizes of the grains, thickness of the deposits, and available sources, Landes[2] concludes that the Pleistocene ash deposits were formed from material derived from Capulin and associated mountains near Folson, New Mexico.

The deposits in Norton county were formed in a water body. The ash deposits are distributed for many miles along the valley of Prairie Dog Creek. This occurrence leads to the conclusion that the body of water into which the ash settled was a lake formed by the damming of a valley that occupied about the same position as does the present valley of Prairie Dog Creek. The original ash deposit probably

covered the entire area of the lake. Subsequent erosion by Prairie Dog Creek and its tributaries cut through and carried away all but the present remnants of the formerly extensive ash deposit. The deposits must have formed rapidly because they contain very little material other than volcanic ash, although they lie upon and are overlain by sand and gravel of the Ogallala formation.

The ash deposits in Norton county vary in thickness up to a known maximum of 22 feet and outcrop or are covered by an overburden that varies up to a thickness of at least thirty feet at places where the ash extends back under the hill.

All mining at present is done by stripping. In some cases the mortar beds of the Ogallala overlie the ash and must be broken by blasting before they can be removed. The overburden is removed by horse or tractor-drawn scrapers and the ash is moved to loading dumps by the same method. Some of the ash is run through fine screens and sacked for shipment but by far the greater part is shipped in bulk, from which the lumps produced by secondary cementation have been removed.

In one of the mines near Calvert in Norton county complete specimens of two large turtles were found buried several feet in the ash. Although the turtles were not measured before being removed, the largest one appears to have been about 30 inches long when alive. These turtles are now in Dyche Museum of the University of Kansas. Fossilized hackberry seeds and the seeds and fruit of prairie herbs are quite abundant in the Norton county deposits. Mr. M. K. Elias[3], who identified these seeds, has found them and also the same species of turtles in the Ogallala formation of Kansas and Nebraska. The Norton county occurrence is the first to be reported in which these fossils are found within the ash. This association is the first definite evidence obtained to prove that the ash and the interbedded clastic sediments are of true Ogallala age; although this clastic series, on a basis of lithology, has long been called Ogallala.

Volcanic ash is used in the manufacture of certain kinds of cement, tooth paste, and scouring compounds. The greatest amount goes into the common household cleansing powders.

LITERATURE CITED

1. Landes, K. K., Volcanic Ash Resources of Kansas: Kansas Geol. Survey Bull. 14, p. 7, 1928.

2. Idem. p. 19.

3. Personal communication.

THE PICTOGRAPHS OF ASHLEY AND DRY FORK VALLEYS IN NORTHEASTERN UTAH[1]

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The region of these pictographs lies at the southeast foot of the Unitah mountains, west of Green river. Here the rocks are all pitched

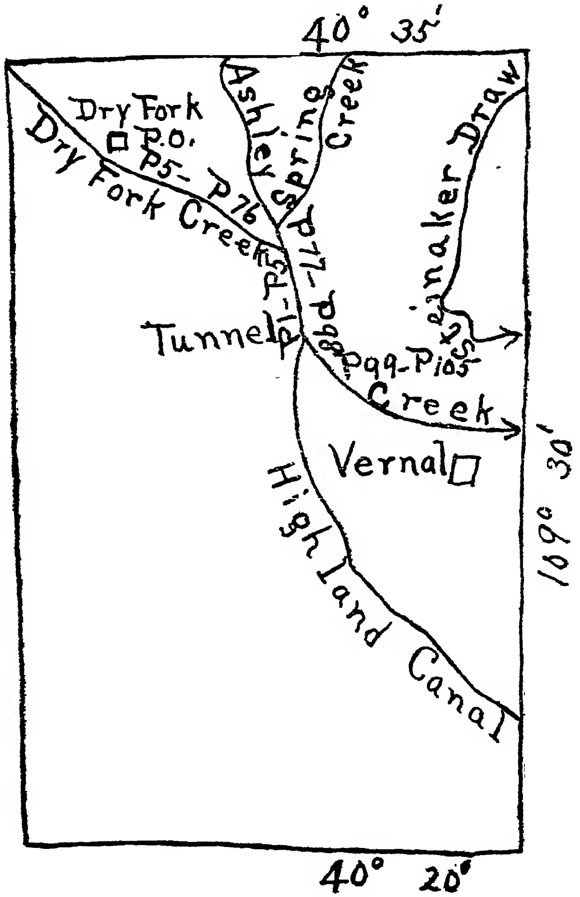

Fig. 1. Map of Ashley and Dry Fork Valleys in northeastern Utah, showing the location of the pictographic groups photographed by the expedition.

1. The pictographic illustrations which appear here are used with permission of the Laboratory of Anthropology at Santa Fe, which furnished the funds for the research work.

It should also be noted here that Mr. Leo C. Thorne of Vernal, Utah, assisted in the work and acted as camera man.

south and southeast at angles ranging from low to almost vertical. Ashley and Dry Fork creeks have cut gorges and, in turn, have widened them but unite to form a wider valley about eight miles north of Vernal, the county seat of Uintah county. (See map, Fig. 1) The valley of each of these streams is a wide-floored canyon that is a quarter of a mile to a mile in width and is generally inclosed in sheer walls that often range from 500 to 1000 feet in height. The greater part of the rock exposed in their respective lower courses, before they unite, is a white sandstone formation, known geologically as the White Cliff Sandstone, of Jurassic age, on whose cliff-faces (occasionally on the cliff-faces of the other formations exposed) there are many pictographs that were made by peoples of the long ago. Below is a description of the photographs in detail.

P1A-C.[2] This series is on the rock face above Cave 36, just north of the rock tunnel of the Highland irrigation canal, seven miles northwest of Vernal. It should be added that the masks, etc., shown here were undoubtedly originally painted over the pecked-in outlines, some of the paint still showing.

P1A. A star (the X) and a suspended necklace show here, the head and body to which the necklace belonged having been effaced by time. There are other figures but the rock face is so marked up with writing and revolver shots that they cannot now be made out.

P1B. Six necklaces, two with clam shell and two with deer-hoof pendants, are shown in this section. The right figure is rubbed in; the others, pecked. The mask has a face represented on each cheek, while it itself represents a horrid face.

P1C. This group shows many different things, among which are six masks, two rain clouds, the lower one showing a rainbow across it, a pouch, a square, a snowshoe, a concentric coil, and several crude figures of men.

P2. This is the pictograph group just below Cave 1. It exhibits a mountain goat which is conspicuous in having its horns turned forward. Among the other figures represented are several men and a snake; while considerably above these there is a partly finished mythical beast. Some of the men are togged out in what seems to be pendent fox tails, which are suspended behind from their waists. The men appear to be dancing; and the whole group seems to depict rejoicing that the goat with peculiar horns has been captured.

2. The pictographic groups which we photographed are numbered consecutively as P1, P2, and so on, the "P" standing for "pictographic group". It should also be added that where a group was too large to be taken at one exposure or where the groups were evidently a part of the same scene, the whole series is photographed under the number for that group or series, with letters added, as P1A, P1B, etc. to show relationship. The pictographic groups seen but not photographed are added in paragraphs in parenthesis as they respectively occur.

P3A-F. This series is just around a point of rock which is called Finger or Shanty Rock, on the west (northwest) side of a canyon, up the Dry Fork road, northwest of the rock tunnel of the Dryland irrigation canal. In continuous drawing, including the drawing of an offset to the west, it is 78 feet long by 12 1-2 feet high. In area and in the large number of clearcut figures it excels any other series of

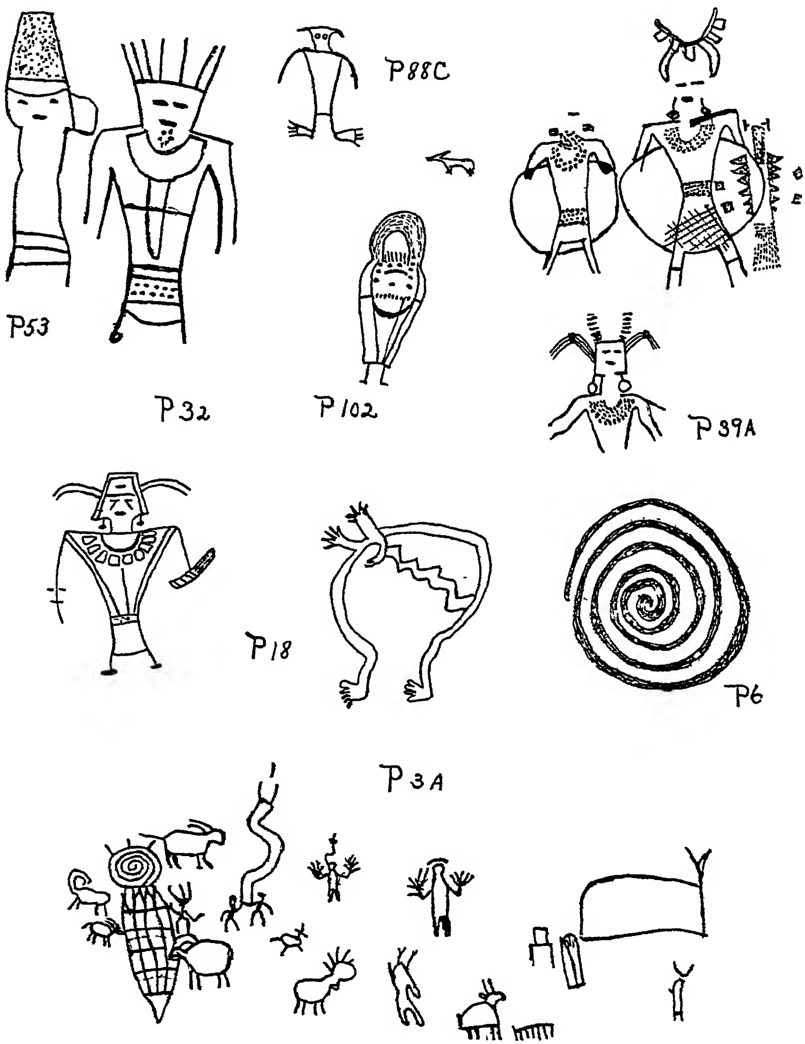

Fig. 2. Drawings of Pictographs. Explanations are found under the the same numbers in the text.

pictographs seen in the whole summer's work, but it is now being defaced by white men's scrawling among and over the figures. These pictographs are different from any others seen in the region and only one series at Nine Mile Canyon (N-P17) resembles them. It is the writer's opinion that they were most likely made by earth-lodge Puebloan people.

P3A. (Fig. 2). Here medicine men are driving mountain sheep into a trap, while an image of the horned or plumed snake is being carried by two medicine men. Deer, a cradle, a rabbit, a six-toed foot and four kachinas are also shown. One of the kachinas has a coiled lightning mask from which three feathers are extended skyward. Another, a woman, has a horned mask, and the other two have feathered headgear. Two bright stars (the XX) are pecked and three faint stars are indicated.

P3B. Some of the figures here are of coyotes and of people with rainbow headpieces.

P3C. The first figure on the left in this section is a human being. The figure is pecked sidewise, not straight as the other figures were. The man is represented as having four fingers on each hand, instead of five. He also has four extended feathers in his head-wear. Besides other drawings, this group also has a drawing of a spider, a tree which is inclosed in a fence that is represented as having feet, a rain cloud, and two conventionalized drawings of corn, almost like some of the drawings of this plant as shown in the sand paintings of the Navajos at the present time.

P3D. In this section of the series the right-hand figure is reaching around the corner of the cliff and is holding by the tail the snake that is shown in P3C.

P3E. The only figure of this group is that of a kachina.

P3F. In this section, the principal figures shown are elk, which are apparently being driven by hunters.

(About the rock face on which this whole series of glyphs is chiseled and back of an offset of the rock there are remains of what appears to have been an earth lodge, or plastered-over lattice-work edifice; and on a bench-ledge over the eastern part of the series there seems to have been a gallery room. It is also reported that some searchers found a gray jar in the debris, about under the section which we photographed as P3D.)

P4. This is a group on the north side of the butte-bluff, up Shanty hollow, about a mile northwest of P3A-F. It shows a large jar and two square-shouldered women. The women are conspicuous in that each one is wearing a short dress and moccasins, resembling somewhat the gala dress and moccasins which are worn by Pueblo maidens on

feast-dance days at the present time. The water jar probably represents the water jar of the skies from which, as a result of certain prayers and ceremonies, water is poured out in rain upon the earth. This Pueblos even now believe. The maidens are probably the care-

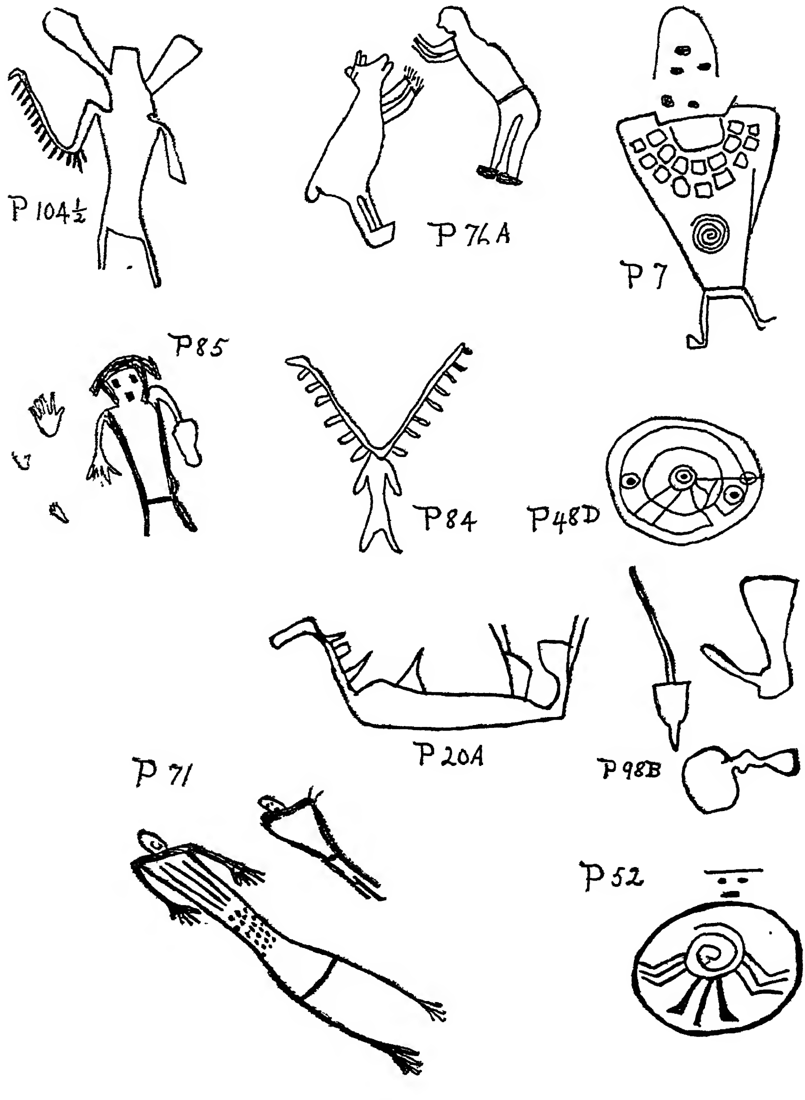

Fig. 3. Drawings of Pictographs. Explanations are found under the same numbers in the text.

takers of this jar. The pictographs of this group are very old and probably belong to the time of the earth-lodge era in the region.

P5 to P75. These groups are all on the northeast side of Dry Fork canyon, the creek here running south 40 degrees east. Group P5 is about two miles northwest of the Dry Fork settlement proper and the former post office and school house site that bore that name, the greater part of the glyphs being along the west face of the cliff, east of the creek, along where it faces the Brystal (Alexander) property, in that valley. Unless otherwise stated, the pictographic groups are separated only by a few feet, each group being southeast of the preceding one unless otherwise stated.

P5. A Coil Group. Two straight-shouldered people,[3] three coils and three people with much weathered headdresses are shown in this group. A man is also shown admiring his female companion, as is indicated by the dotted line connecting their eyes.

P6. (Fig. 2). This consists of a single concentric coil.

P7. (Fig. 3). This group consists principally of a large woman with a coiled lightning decoration on the front of her dress. She is also wearing a very elaborate necklace of two strings of very large pendent shells(?). Her head-wear is represented as roundish, probably consisting of a basket cap.

P8. (Fig. 4). The Bear-Flute Player, Head Hunting Group. Two scenes are represented in this drawing, one superimposed on the other. The first is a bear dance scene, in which a flute player is playing while lying on his back. The drum, apparently an inverted basket, and its notched drum (rubbing) sticks are shown in the middle foreground. They somewhat resemble the present Ute notched sticks and basket resonator as pictured by Miss Densmore. To the left of the picture a bear and a man, who is represented as having a roundish body, are dancing toward each other in the characteristic style of the drawings which at the present time are placed by the Utes on a piece of cloth (the bear-dance banner) and hoisted on the west side of the bear dance corral at bear dance times. The picture also shows a man standing, apparently behind the bear, and probably representing the man of ceremonies of the occasion.

3. Straight-shouldered or square-shouldered, as used in this article, does not mean that the people represented were straight-, or square- shouldered, but that the drawings representing them were drawn by the then prevailing square-shouldered style of drawing human figures. In this article, square-shouldered drawings usually refer to the drawings made by a post-Pueblo people, not by the Basket Makers who preceded the Pueblos and likewise drew square-shouldered figures to represent human beings. The main distinction between the two is readily seen in the hair-dressing of the Basket Makers and the elaborate and gorgeous headgear of the post-Pueblo peoples and in the glyphs they left so often exhibiting them as head hunters.

4. Densmore, 1922, pp. 26-27, pl. 5.

The superimposed picture is that of a head hunting party being attacked as it is returning with head trophies. It should be added that at least a part of the figures of both groups were painted over the pecked-in outlines, as patches of red paint still show. The bear dance scene is much older than the square-shouldered, head-hunting scene.

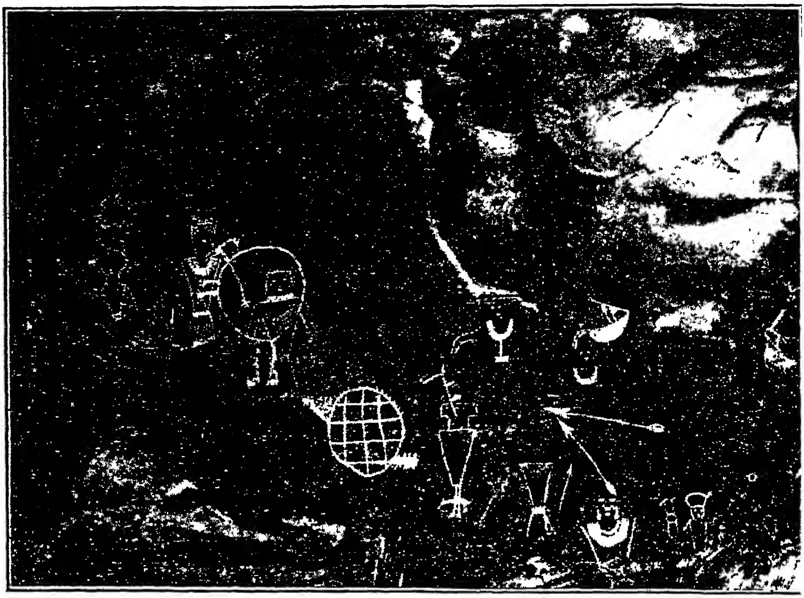

Fig. 4. Pictograph P8, A Head Hunting Scene is here superimposed on a bear dance scene in which a round-bodied person is dancing to a bear. Such a scene is now pictured on the Ute flag that is hoisted over the west side of the bear dance corral in Ute lands, except that the human dancer is here drawn in the round-bodied pattern.

P9. Three badly weathered figures of human beings are shown in this group, one of whom is wearing an owl mask and another a bear mask.

(Just above this scene there is a drawing of a large circle, near which a human head is represented as lying on a boulder. Behind a large boulder, one hundred feet almost due east of this drawing there is an elaborate drawing on the main cliff wall. A hundred feet still farther to the east there is another scene which is so poorly drawn and so weathered that we could not photograph it. This last drawing has several square-shouldered people represented in it, one of which has a somewhat roundish hat. One of the figures is wear-

ing a large shell(?) necklace, and another has several strands of beads suspended over his breast.)

P10. In this group two men, the figure of one now partly effaced by weathering, are represented as carrying two human heads. These figures are superimposed on the drawing of some animal, which represents the work of a former time.

P11. This is a drawing of a feathered, circular mask.

P12. The drawings of this group probably represent the sun and moon. The upper figure, the moon, has a circular body, with head above and with neck extending down into it, with arms extending outward from the bottom of the neck to the rim of he body circle. The other drawing also has a circular body, now lacking the outlines of head and arms as the result of centuries of weathering. The three rays from each inner circle probably represent the sun's rays as they appear through a gap in the clouds, the whole drawing probably representing some of its mythical or conventional phases.

P13. The Arm-Band Group. This group is between pictographic groups P9 and P10. Four human figures are shown in it, one having taillike feet.

P14. An incomplete figure (or the figure of an insect) and figure of a man who is holding a fancy pipe(?) or a flute in both hands make up this group.

P15. This scene is that of a group of head hunters returning with a captured head, from which blood is represented as still streaming.

P16. This drawing is of a dancer with a large head ornament. He is represented as wearing two strings of large beads suspended over his chest.

P17A-D. The Siamese Twin Series. This series is sixteen and 1-2 feet high by twenty-one feet long and the upper figures and the square-shouldered figure immediately beneath them are drawn in almost life size. The series separates itself into four groups.

P17A. This is the upper group and is composed of four square-shouldered human figures, with square heads, the left one of which is now so much weathered that parts of it could not be made out. The middle figures, each of which is wearing a striking hat, are joined together like Siamese twins.

P17B. This group is immediately beneath P17A. The figure to the left is a square-shouldered drawing of a large man, superimposed on a circular-bodied drawing. The large figure is rubbed-in, the circular one, pecked-in in broad lines. A coyote and a crudely drawn square-shouldered person show beneath the large figure's right arm. The next figure to the right is a round-bodied individual, with body

belt and conspicuous headdress. He has ray-triangular figures extending to the belt line from the lower part of his body. His feet are out of proportion to the rest of the figure. His right foot touches the head of another circular-bodied drawing, on which the foot is superimposed. This latter drawing is superimposed on another drawing which is so disfigured by it that we could not make it out. Below this last round-bodied figure there is a square-shouldered person who is carrying something suspended at his back. The figure on the right is that of a round-bodied woman whose breasts are represented by small circles. This figure, in turn, is superimposed on two or more pecked-in figures that could not be made out.

P17C. The two upper figures of this group are of the circular body type. The male figure has his arms drawn across his body from the neck, in triangular shape. He has a belt around his body and is wearing a large, much-worked headgear. His female companion, also drawn in circular-body form, shows her breasts. Below her the figure of an owl is drawn; and obliquely below the male figure there is a square-shouldered drawing of a man. There appear here many other glyphs which are more or less covered by other drawings or are too worn to be made out.

P17D. This is an odd, round-shouldered drawing of a man.

The square-shouldered figures of this whole series are all rubbed and the others, pecked-in in broad lines, then rubbed over afterwards to complete the work. The drawings also show that they have been painted over the pecked-in or rubbed outlines, the red paint still appearing on the large circular-bodied, male figure of P17C, and also on the left figure of P17A. They conclusively show that the square-shouldered figures were drawn much later in time than the round-bodied ones.

P18. (Fig. 2). The figure here shown is probably "Old Man Lightning".

P19A-B. This series, which is eighteen feet high and thirty-five feet long, consists of an upper and a lower group.

P19A. Five life-size pictographs of human beings are depicted here, as the upper figures of the group, only one of which can now be made out entirely. Below these there are parts of a head and the necklace of a figure that is now all but effaced. The head and circular body of another figure and part of a drawing of some mythical beast are also shown, the latter being partly superimposed on the round-bodied drawing. (For a more complete outline of this beast, see P20A and P20B.)

There is still some red paint on each of these figures, which shows that they were originally painted. The group next below shows that its figures were also painted over a pecked-in outline.

P19B. Several figures of this group could not be made out. A square-headed, square-shouldered figure is superimposed over a circular-bodied one so that their heads almost coincide, while their feet are identical. A square-shouldered figure is carrying a bleeding head and is dragging another victim along with him. Above him there is the head of a circular-bodied figure, on which a square-shouldered drawing of a human being is superimposed. A dancer is following these actors.

P20A-C. The Arrow-Mythical Animal Series. This divides itself into three groups.

P20A. (Fig. 3). A mythical beast is shown here.

P20B. The same mythical animal and the side view of a man are here shown.

P20C. The Arrow Section. In addition to a man and a closed concentric circle, a man is shown who has been shot through the legs with a large arrow, as another arrow is being dispatched at his head from the opposite direction. The enemy is not shown on the rock face.

(For nearly a quarter of a mile toward the southeast along the rock face of the cliff from P20A-C the rocks are not suitable for the making of pictographs, the only pictographs in this whole distance being the next below, P21.)

P21. The glyphs here are a star and a rainbow, under an overhanging rock. The rainbow is represented as having forked lightning descending from it.

P22. This group consists of a square-shouldered, square-headed human figure.

(One hundred yards southeast of pictographic group P22, thirty-five feet above the general pictographic level, several drawings show on a smooth exposed wall, one pictograph being that of a square-shouldered person. The drawings could not be reached in any manner in our time, except possibly by ropes from above, the rock support which the artist climbed over having been removed by the elements since that far off time.

There are several other inaccessible pictographic groups on this same level in this vicinity.

It is an eighth of a mile below (southeast of) P22 before the rocks of the general level, just above the talus-slope bench, are again suitable for the making of pictographs; and it is still quite a distance on southeast before they are decently smooth. The artist often had to rub these rocks in an effort to get them smooth so that he could make his drawings upon them.)

P23. This crude drawing, which is just above the floor-level of the talus bench, was probably made by children.

P24. This group, which is one hundred feet southeast of P23, is composed of three figures, one of which is almost worn away. The others are of two men who are wearing buffalo-horn headgear.

P25. Four people are represented here as dancing and a lady with a tall headdress is shown looking on. A woven(?) bag is pictured above the dancers, probably being the prize which the best dancer is to receive.

P26. This group is behind a very large boulder, as a result of which only a part of it could be photographed. The characteristic thing is that two people are tied together with a rope. What this signifies cannot be determined from the drawing. The boulder fell after the glyphs were made.

(About forty feet southeast of P26 and seventy feet above the general pictographic level there is a large smooth rock face which faces the valley. On this there are drawings of the circular-bodied glyphs of men. Seven feet to the north of these drawings there is a pictograph of a large bear charging toward these men, as the feathered lightning snakes project from its mouth. This scene probably depicts an (imaginary) bear doctor scene in which the bear shaman had power to turn himself into a grizzly bear, in which form he proceded to destroy his enemies, the men in the scene being enemies of the bear actor, a belief that was almost general throughout California. See Kroeber, 1925, pp. 854-855, and "bear shaman references", p. 971.)

P27A-B. This series divides itself into two groups.

P27A. The characteristic thing about this group is a flute player lying on his back playing a flute. Besides several other figures of unknown significance, a running deer is shown to the right of the flute player, while to the right of this group there is a dancer togged-out in gala attire, beneath whose elbow there is a concentric circle of the open type, much resembling a coiled rope.

P27B. This group is crudely drawn and was probably made by children.

P28. This group is composed of a single figure of unknown import.

P29. This group is composed of a crudely-made red-painted figure of a human being.

P30. A Head-Hunting Scene. Two men are carrying heads. Besides a now incomplete figure, five other men and a woman are shown in this group. The latter is conspicuous in having a cord skirt. It should also be noticed that one of the captive heads and two of the men are represented as having "slant eyes".

P31A-B. This series is on a large boulder, near the cliff wall,

P31A. This drawing is on the southeast face of the boulder. Besides several figures, which are now incomplete due to the fact that parts of each have been removed by weathering, a goat and a kid(?) and a dancer are shown. The latter is wearing feathers in his hair and has an elaborate necklace.

P31B. This drawing, which is on the south end of the boulder, is that of a person who is carrying a string of beads in each hand, probably representing Indian money.

(On the main cliff wall back of this boulder there are many drawings, now nearly effaced by weathering, which, for the most part, have been painted, instead of pecked.)

P32. (Fig. 2). This group consists of a single head hunter, with his knife in his left hand. The knife has five notches cut in it and this, no doubt, is the record of the number of persons he has decapitated. In the glyph, as originally drawn, he was probably carrying a head with his right hand, as the eyes and mouth of such a figure are now shown at the end of his hand, time having effaced the outline of the victim's head. Attention should also be called to the fact that this person is represented as having slant eyes.

P33A-B. A Head Hunting Series, the return of the victors with the heads of the vanquished. This group covers a rock area which faces the noon-day sun and is eleven feet high by twenty feet long.

P33A. The central figure here, Big Feet, is carrying a captured head suspended from his left elbow, while in his right hand he is exhibiting the war club with which he killed his victim. A dagger-spear is also shown behind him at his right. The captured head is either represented as crying or as being a slant eyed person. Below his (Big Feet's) right are there are several superimposed. much mixed-up, badly weathered figures, which could not be made out. To his left there is a much decorated human figure wearing a horned headdress and brandishing a spear in his left hand. He is also holding a freely bleeding head in his other hand. At Big Feet's right are three be-togged head hunters, the left figure being so worn and weathered that we left it untouched. It is quite likely that some of the detail features of the other figures have also been effaced by time. The figures were all originally painted in red, blotches of the red still showing. Attention should also be called to the fact that one of the head hunters and one of the captured heads that Big Feet is carrying are represented as having slant eyes.

P33B. The crudely made figure of a human being at the extreme right of the series is painted in bright red.

P34A-B. A Head Hunting Series. This series is twenty-three feet long by ten feet high.

P34A. The Head Hunting Scene. Three heads are being carried here, The heads, which the woman with the cord skirt is helping carry, are much battered and one is represented as crying. The high-hatted gentlemen in the center seems to be much decorated and is probably the chief. The woman to the left of the woman with the cord skirt has five solid rows of beads for a necklace. She is represented as having slant eyes; and if, as some suggest, she is represented in this way as crying, one wonders if this group is not bringing home the heads of relatives, heads which they have recaptured or ransomed from an enemy. The chief's legs were shortened by the artist because there was not room for them on the rock below his body. They show also that he might possibly have been bow-legged.

P34B. This group, which was painted blue, consists of an open concentric coil, a man, and a combination which might possibly represent a funeral pyre.

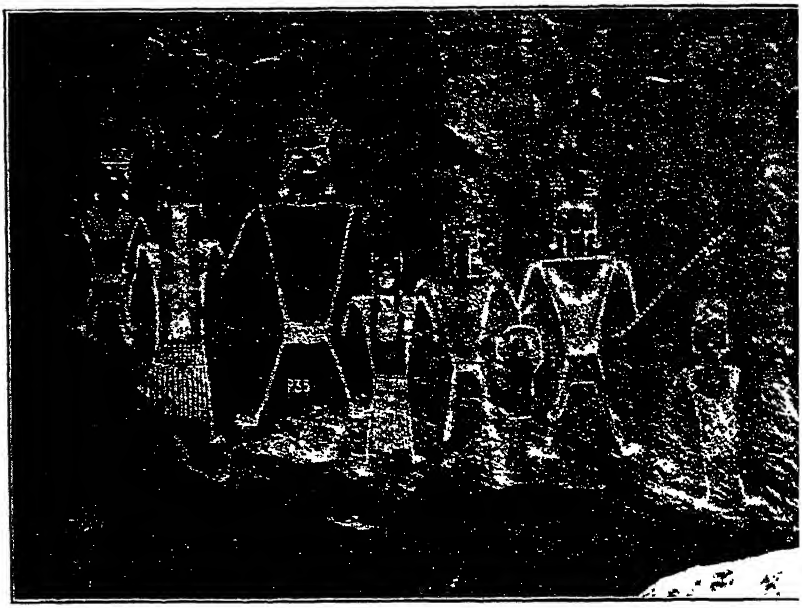

Fig. 5. Pictograph P35. A group of head hunters returning with captive Puebloan women and children and the heads of the braves who attempted to defend their homes. Notice that one captive woman is wearing her hair in the present Hopi style of wearing the hair, especially to show that she is a virgin, and that both of the women are wearing cord skirts, which were probably made of woven shredded cedar bark.

(The Jurassic formation, the formation just above the Red Beds, terminates here in a shale streak four feet and four inches thick at the base. These shales have been ground into powder and used as paint. So far, however, the source of the red paint has not been as-ascertained.)

P35. (Fig. 5). A Head Hunting Scene; Bringing Back the Captives. Two men are carrying a head between them and two women are being led as captives. Both of these women are represented as wearing cord skirts. The left one is presenting a back view and has her hair whorled over her ears as a Hopi virgin wears her hair today and as many photographs show females wearing their hair. Such glyphs are scattered here and there throughout the Navajo-Hopi country and other parts of the Plateau region.[5] She seems to have an immense bunch of loose hair extending down her back almost to her waist. The two women are undoubtedly captives, as each is being held by two men. Beneath the man between the two women is a flute player, lying on his back and playing a flute, a flute player who much resembles the flute players of Kidder and Guernsey in the publication, above, Fig 96. The head hunter to the right of the captured head is holding a long flute, or a string of money beads, in his left hand. On his left is an Indian girl about ten years of age. If it is a string of money beads the head hunter is holding, he is, no doubt, showing what ransom will free the captive woman or did free them, if the scene is recording a past event, as it most likely is. The California tribes appear to have had similarly the custom of holding women slaves for ransom at a value of one or two strings of beads.[1]

It should be mentioned that the captive head and two of the head hunters are represented as having slant eyes.

P36. Only a part of this group is shown in the photograph. Besides a square-shouldered drawing of a man and a part of a woman's figure that could not be properly made out, due to its weathered condition, two complete figures of men and a part of a woman's figure are shown. The lower figure is round-bodied, with a necklace of teeth. The large woman, who is much decorated, shows a back view, with hair whorled just as Hopi maidens wear their hair, as mentioned under P35.

P37. A breaking-off of the rock has destroyed a part of this group. Besides a crude human figure, a woman, three men, and a deer are represented. One man has half his head and his right shoulder chipped off by the breaking off of the rock point on which they are pecked. The woman has her lower parts missing for the same reason. The man in the center of the picture is represented as standing

5. See Kidder and Guernsey, 1919, p. 94, pl. 90; and Fewkes, 1917, p. 8, Fig. 3.

6. See Kroeber, 1925, pp. 24, 72, 573, etc.

on a boulder; and, as a result, one wonders if he is not some sort of a religious personage, as the person represented as standing on a ball in P70 undoubtedly is. The man here is wearing a dancers kilt. The human figure near the pecked beast is holding a circular object in front of him, probably a representation of the rainbow, or a hoop that was used in the polo game. The other figure is rather crudely drawn.

P38. This picture, which is now slantingly presented, is on a large boulder which has fallen since the picture was made. A female goat, drawn more like the Arizona goat drawings as given by Kidder and Guernsey (Pls.89 and 94), than the drawings of goats usually found in this section, is shown as the lower figure. The other glyphs present the lower parts of a man and the necklace he wore around his neck, the rest of his figure having been worn away.

(Fifty feet southeast of this drawing there is part of a circular-bodied figure, so high that we could not get to it. Above this group there is also a painted figure which is so high and so worn that we could not make it out. And seventy feet still higher above the ordinary pictographic level, there is a square-shouldered pictograph of a human being.)

P39A-B. The two groups of this series are on the same rock face. being separated by a large crack. The drawings are characteristic in that they are superimposed on much older pictographs. The older figures were pecked in with a very fine pecking (or were drilled in with tiny drills) but little larger than drop-size. Where these holes were in the way, they were smoothed over before the later drawings were made. The later drawings were rubbed in over pecked outlines. Of the older group of pictographs, only parts of the figures of three women can now be made out.

P39A. (Fig. 2). The figure of a woman of the older pictographic group shows here, with rainbow-hoop drawing of the later series superimposed on it. This woman has the characteristic whorled hair, as now worn by Hopi maidens. She is also shown in rear view, with much loose hair hanging down her back to her waist. Her dress above the waist is decorated in extending, flag-like triangles. Below her waist she is attired in a cord skirt. Her waist and arm bands still show but her arm and hand outlines have been removed by time.

The upper two male figures of the more recent drawing are carrying imitation rainbow hoops behind them, or they may be carrying hoops to be used in the hoop-pole game, though the hoops appear to be too large for such use. A part of the head of each man is now missing. The lower figure of the group is much decorated and heavily beaded and is probably a woman.

P39B. This group lacks parts of the right two figures, due to the wear of the elements. The lower left-hand figure is much beaded. It has a large, showy necklace, a wide stripe across its lower chest, and a beaded belt. It is superimposed on another figure. The Indian lad at the left of this figure is wearing a fringed sleeve on his left arm. The next figure on the left of the Indian boy is a crudely made, square-shouldered figure placed by the last artist on the lower part of the figure of a woman of the older drawing. The cord skirt is a part of the dress of the much older drawing which the later artist appropriated and the skirt is much longer behind than in front. The dim outline of the rest of this earlier drawing can be seen pecked-in, in part, in fiue peckings or drilled holes behind the superimposed, square-shouldered, upper part of the drawing.

The tall figure in the center is square-shouldered and well drawn. The woman with the cord skirt at his left has her upper part mostly erased and another figure has been drawn over it. A part of her head appears, however, showing a face view with Hopi style of hair dressing. The figure at the extreme right, not included in the photograph, cannot be made out, unless it is some masked personage. Beneath it are faint outlines of a pecked-in necklace, waist, hands and arm bands of a drawing of the first period, the figure being now too worn to be chalked in.

P40. This is a circular-bodied group, some of the figures having hands, some, legs, and some, both hands and legs. The figure on the right has a buffalo-head ornament and is shown extending his hand. The separation of his body from his head is peculiar, as it is in the case of one other figure. The figures are all pecked-in on the hardest kind of rock and were no doubt completed, the now missing parts having been removed by weathering.

P41. A Head Hunting, Bear Dance Scene. This group is drawn on very hard sandstone. It has suffered much from wear, besides it appears to have one drawing superimposed on another. The posing figure, whase arms and parts of whose body and head are now effaced by wear, and the prostrate figure are evidently part of a bear dance scene at the endurance-test stage. The attitude of the posing figure is very similar to that of the posing figure in pictographic group P76, which will be described later. The figure of the bear apparently has been removed by weathering. The acting in pictographic group P8 is very similar, the bear still being represented both in P76 and P8. The prostrate figure has no doubt fallen from exhaustion, as in scenes which can be witnessed at Ute bear dances of the present day.

The section to the right of the crack is a head-hunting scene. The body and arms of the head hunter are now missing, due to the wear of time. His unusually large feet are very noticeable. He is carrying a captured head which is shown as having slant eyes.

(A large block of rock has fallen from just beneath these pictographs; and on the wall back of this space there is a circular figure, which is painted blue. It is ten inches in diameter, with a line running through it vertically, from the top of which a handle, almost in revolver-shape, projects to the left. This drawing probably represents a bird.)

P42. This group consists of a man and a snake.

P43. The only figures of this group are two round-bodied men, the smaller one having his whole body pecked-in.

(From this group southeastward down the face of the bluff there is a marked change in the character of the pictographs. The square-shouldered and round-bodied figures, however, still occur, usually with modifications, with other characters coming in.)

P44. This is a single figure, that of a man whose eyes, nose, and body are outlined by large pecked marks. Probably this was a painted figure but the paint has entirely disappeared due to long weathering.

P45. In this group five human heads are represented by eyes and mouth, and two by a partial outline of the body of each, weathering having effaced the missing parts.

P46. Six persons are here represented by eyes and mouth peckings, the bodies of the respective drawings having all been removed by time and weathering. Below these partial figures there is a complete, rubbed-in figure of a human being, showing a rear view.

P47. The principal figures of this group are those of a man and a child.

(Near the left margin of the area covered by P47 there are also pictographs of several square-shouldered people, now nearly effaced; and ten feet above these there is a large painted circular drawing, now almost obliterated.

Just around a corner of a rock east of this drawing there is an open, concentric, circular pictograph, one and one-half feet in diameter. Ten feet farther down the wall southeastward, in a niche twenty-five feet above the level of the top of the talus-slope bench, there is a red, almost obliterated, drawing of a woman, whose breasts are represented by circles. At the general pictographic level there is a square-shouldered drawing of a man, with heavy-beaded necklace.)

P48A-D. The Target Series. This series is scattered over a wall that is twenty-five feet long and ten feet high, all above a shelf-bench which is fourteen feet above the top of the talus slope, which, in turn, is here 250 feet above the general level of the Dry Fork valley floor adjacent. The figures represented have all been painted red and occur in groups, as follows:

P48A. In this group three arrows are shown.

P48B. A woman who is represented as having slant eyes is here shown carrying a little tree beside her head.

48D. (Fig. 3). This is a drawing of a large concentric circle four and one-half feet in diameter, used as a target. It is drawn to represent a woman(?), her breasts being represented by double circles. Her heart, around which several concentric bands are drawn, is the target. The outer concentric band was not incised but was painted in red, the paint now being nearly obliterated. The boundaries of the other concentric bands are deeply incised. From the outer red band, triangular, red spaces extend to the heart center at regular intervals, only one of which now shows plainly, the others being nearly effaced by the wear of the elements. The drawing shows an arrow driven straight to the target center.

As mentioned, this drawing seems to be the circular body-part of a woman; but, if it is, the head and appendages have been effaced by weathering, probably having been painted instead of incised, the whole probably representing the imagined or conventionalized face of the moon.

The whole series probably represents an archery scene in some puberty ceremony, the other figures of the scene probably having been removed by wear. The lady carrying the little tree is probably the one for whom the ceremony is being conducted.

P49. The Snake Group. Some of the figures of this group are pecked and some are painted in purple paint. There are indications that the whole surface of this rock front was entirely covered with painted pictures, mostly purple in color, and all of them mostly of the circular type. Such as we could make out are here given: three masks, an elk, a mountain goat, and two circular figures of men, one of whom is apparently waving a rope or a string of money beads with each hand. A barred circle and part of a chambered circle are also shown.

P50. This group consists of a pictograph of a single individual.

(In the valley at the foot of the talus slope, about due west of this (P50) group, there is a circular, walled-up hole four feet in diameter and three feet deep, which probably represents a walled-up spring that flowed long ago but is now extinct. The wall is composed of well laid-up cobbles. We dug in this walled enclosure but found nothing of value.)

P51. A Mythical Beast Group. Besides the glyphs of a man, two peculiar, small drawings, and the partial drawings of three human beings whose bodies were effaced by wear, the characteristic figures appear to be those of mythical beings. The left one, represented as

a female, is superimposed on two human pictographs. The other has its head and legs missing, due to wear, and a breaking off of the wall has removed its rear parts. The left figure also has its legs wanting, and it is so superimposed on the two human figures that the hands of the right human figure are shown beneath it, in the act of dispatching an arrow from a bow. At its rear the lower part of the human pictograph at the right is shown just behind it, over which its legs are probably pecked. The feet shown were probably the feet of both the man and the beast together, the upper part of the human figure having been removed by the wear of the elements. We have previously seen this beast in pictographic groups P19A, P20A and P20B.

(Forty feet above this group, under an overhanging rock cap, there are four deeply incised figures, two on the north and two on the east wall of the cliff. The two on the north wall are of men who are elaborately attired, each wearing gorgeous necklaces, both being drawn according to the square-shouldered style. The two along the east wall are of women who are wearing dancing kilts. These figures, besides being incised, are painted in red.

About 200 feet northwest of this (P51) group there is a horizontal bar, ten feet in length, from which three legs extend upward four or five feet. These and the bar are all made in heavy lines, two inches wide and, as a whole, closely resemble an upturned, elongated table, from which one of the legs has been removed. Its purport cannot be imagined.

High up near the crest of the rock wall, about halfway between this (P51) group and P60 there is a large cave facing about westward. As it is at least 500 feet above the talus floor it is inaccessible from the valley side. However, by tortuous climbing it can be reached from the top of the mesa above it. Parties who have visited it report that it contains corncobs and other refuse.)

P52. (Fig. 3). This drawing is a third of a mile down the cliff front southeast of P51, there being no pictographs in this third of a mile, due to the rough surface of the rocks exposed in the area. It is composed of two figures, both of which are of the coiled lightning type. Undoubtedly they were very similar before the wear of the elements effaced a part of each. The upper figure is inclosed in a deeply incised circle two feet and eleven inches in diameter, this being the circular body of a person. The eyes, mouth, and forehead show above the circle but the rest of the head has weathered away. The whole figure is probably a conventionalized form of lightning, or the two represent conventionalized forms of the sun and moon.

(Eighteen feet above the talus slope bench, near the rock point (cliff turn), about one hundred feet northwest of P52, three square-

shouldered drawings of human beings are pecked on the north surface of the cliff. Near these are drawings of two men who have elongated, square-cornered bodies, with feet showing. Near these is the circular body of a woman, with breasts represented by circles. The two men and the woman are wearing striking headgear and gorgeous necklaces. These figures have all been painted in red.

On the general pictographic level, about halfway between this group and P52, there is a concentric circle group. The first figure is composed of a concentric circle of chisel marks. The next is a circular figure, one-half of which is filled in with chisel marks and the other half with rotating, strong lines. Another wheel-figure has half its interior filled with strong rotating lines, radiating out from the center; the other half, with radiating dots.)

P53. (Fig. 2). This group is composed of two figures of women. One is much decorated, the other crudely drawn, with a bunch extending over the left ear. A similar bunch was over the right ear, faint traces of it still showing. The two bunches probably represented whorled hair.

(Between this group and P52 there are faint outlines of square-shouldered people, and similar pictographs are also shown on down the face of the cliff for a distance of forty feet farther to the southeast.)

P54. The upper figure of this group is a man who has four fingers on each hand, peculiarly placed up the arm. Besides several other figures that were too worn to be traced, a five pointed star is also shown.

P55. This is a painted group, the paint used being light brown. Three vertical, parallel, wide bars and two seven-pointed stars are shown on the rock face.

(About thirty feet southeast of this group there is another group of much worn pictographs. The center one of the figures that can be made out is square-shouldered. The one to its left is probably round-bodied, while the one to its right is crudely drawn as a square-shouldered figure. The last figure seems to be wearing a cord skirt.

P56. This group shows the figures of two men, with a square object between them and below their extended arms. There is also a five-pointed star about midway between their heads. The figures both to the right and to the left of these two men are worn pictographs of human beings.

P57. The three painted figures of this group are under an overhanging rock. The central figure is painted white; the other two, in red, as is a drawing on the opposite wall. These figures are all of the square-shouldered type. Two figures nearby have suffered much from weathering.

(One hundred and fifty feet southeast of the above painted group there is a much weathered pictographic group, depicting three square-shouldered men. Twenty feet farther toward the southeast there are three more much worn pictographs of human beings.)

P58. The figures of two square-shouldered men with forked-tasseled headgear, are shown in this group, the lower extremities of each now being missing, due to weathering.

P59. This group consists of a much decorated individual, about whom are many other figures which are too worn to be made out.

(From P60 to P70 the pictographs are probably all the work of an entirely different people, as they are different from other pictographs, in that they are more or less star-sun drawings, maze scenes, zigzags, triangles, and so on. It would also seem that they are the oldest glyphs in the region, as, in places, they have been rubbed over (rubbed out) and square-shouldered and round-bodied figures pecked or painted over them, and they themselves are not found superimposed on any other drawings.)

P60-P64. These groups are along the same rock face, above a high bench. The estimated length of the cliff-face, where the glyphs are pecked is 150 feet. It must be reached by ladders, and at places the ledge just beneath it is so narrow that it is dangerous, as it is fifty feet above the talus slope.

P60. This group consists of four figures, fifty feet above the talus slope. One is a circle, another a concentric circle. Another is a concentric, circular-wagon-spoke bodied individual, with short, stubby feet, and an owl-like head, minus a neck. No hands are shown.

P61. This group consists of a feathered or rayed concentric circle, with tail appendages. Near it, to its left, is a plain circular disk about the size of the disk of the other drawing. It is easy to conjecture that these two drawings represent the sun and moon.

P62A-B. This series of glyphs is on a ledge-front, fifty feet above the talus slope, seventy feet northwest of P61.

P62A. The main figure of this group represents a mythical beast of some sort. The greater part of it has been erased by rubbing, probably for the purpose of placing another picture on the same space, an intention which was never put into execution. This group also shows a square-shouldered man who is wearing his hair in side bobs.

(Near and just to the northwest of P62B, next to be described, there is a pictograph picture of a beast similar to the one shown in P62A. Over most of it a circular-bodied human figure has been rubbed, thus obliterating its outlines. Near this figure there is a superimposed square-shouldered drawing of a human being whi is wearing a buffalo head as a headdress.)

P62B. This is a group of dance actors, one of whom is wearing a horned headdress.

(There are many other drawings on this rock face, all too much worn to be made out in detail. One of these is the figure of a woman with a crescent-shaped head. A large, round-bodied figure has also been pecked-in, then later rubbed smooth, as if for the painting of a picture on the same surface. This figure was superimposed on the drawing of a mythical beast, so disfiguring the latter that its outline cannot now be made out.)

P63. This group consists of a rayed circle, with a star center which has six points, the whole being probably a drawing of the sun.

P64. This group is in a little niche-corner on the cliff face, fifty-four feet above the talus floor that here abutts the cliff. Its principal figure is a woman who is sitting on a rainbow (circle) and has a crescent moon head. The other glyphs near this figure are also of people.

P65. The Rayed Circle Group. One rayed circle at the extreme left has a star for its center; another has a dot. One concentric circle is rayed on the concentric circle next to the last concentric ring, giving it wagon-spoke appearance. One unrayed concentric circle has its outer rim extended into the body of a man, the concentric circle being his head. A side view is shown and within the body part is the drawing of a goat. One concentric circle extends downward into a zigzag-lightning line and connects itself with some horned beast. One rayed concentric circle is horned and has legs and feet. Between it and another concentric circle there is a man so placed as to appear to be walking. He has peculiar head-tassels and is holding to one of the concentric circles with each hand as though he were carrying them. It is suggested that the one circle is a moon figure and that the other represents the sun. Several heads of men and of goats also appear on the wall in the vicinity of these circles.

P66. The Buffalo Headdress Group. This group exhibits five complete drawings of human beings. The central figure, which is represented as having very large hands, has a buffalo headdress. The lower figure at his right has a buffalo head near him. The upper figure, which is near a snake, is the crude likeness of a man, such as is depicted on the rocks in the Navajo country. The lower figure to the right is an elaborate headdress which seems not to be connected with any person. It resembles some of the headdresses worn by the Pueblos at the present time. The person immediately above it lacks his head outline, due to weathering.

(High on the rock wall between this (P66) group and the next, there are several drawings which are so effaced that they can scarcely be made out. They are mostly of men in dancing attire. A rayed

star-drawing also shows. Farther up the same wall, across a large crack, there is a well-defined drawing of a stout man, with hair done up in side locks. This figure was inaccessible, or we would have secured a photograph of it. A similar figure occurs in pictographic group P75, except that in the latter picture the man is carrying a rake-like stick.)

P67. A Maze Drawing. Two men are represented as driving three goats into a maze trap. The sun and moon are also represented,—the circle, and the man with the inverted new moon over his head. The large man is wearing a buffalo head as a hat. That the mass figure is a trap-corral is suggested. On the other hand this drawing and several others of like character would seem to suggest the imagining of a distorted brain.

P68-P69. Another Maze Series. The upper figure, which is apparently enmeshed in the maze, is that of a woman with hair done up apparently as Hopi virgins arrange their hair. Below the maze are a buffalo, a suspended spider, a deer, three goats, and a kid. The central figure is a man with an animal headdress. He seems to be trying to rope the largest woman represented, while a smaller woman is looking on.

P70. The Sacrificial(?) Group. The central figure of this group is a slant eyed man who is carrying a pendant, suspended from one hand, and an odd-shaped object in the other. He is standing on a ball and has a large-sized, feathered headdress. To his right, at a little higher level, is a head, with hair extended out on each side, almost like horn projections, probably representing side locks. An idol(?) is depicted standing on a platform to his left and a man is represented as making offering to it(?). It is the writer's opinion that the whole scene is a sacrificial one and that the man standing on the ball is a priest shaman, the other man being his attendant. He further believes that the purpose of the ceremony, of which we see only a part, was to sacrifice the captured Basket Maker head to the idol. This, of course, is only opinion and may be modified at any time upon obtaining more data.

(On the rock wall, 20 feet east of P70 (here we find an east turn of the cliff wall), there is a drawing of an individual with a horn-headdress. Below him is an open concentric circle ten inches in diameter and to the left of this is an incomplete, open, concentric circular figure. On an adjacent wall, a crack separating the sections, there are several other figures which are incomplete due to weathering, one being an individual with an elaborate headdress. Above these two sections there is another set of glyphs, covering a face twenty feet in length by four feet in height. On the west margin of this area there are crude drawings of three men and a snake. Near the east

margin there is a mountain ram chasing a man. And to the east of these there is the large figure of a square-shouldered man who is wearing a headdress which has a circular dotted top a foot high.

In the mouth of a hollow, 200 years northeast of P70 there is a giant pillar, photographed as L-1 of this series, and called Giant's Club Rock. About it there are several pictographs.

High on the rocks, halfway between Giant's Club Rock and P71, there is a drawing of a square-shouldered, square-headed person of large size.)

P71. (Fig. 3). This group is one of the two boulders in the mouth of Cave 6. On one of the boulders the drawings are of snakes; on the other the glyphs photographed are figures of two men. One of the latter figures is not complete, the feet of the other are bird-like. Both men have small hands and their headdresses are conspicuously small. They seem to be dancing the "Tango". The Ouray Utes think that these drawings were made to represent falling meteors. They further say that they make similar drawings to represent the spirit-body of such heavenly visitors.

P72. (Fig. 6). The Return of a War Party of Head Hunters. This group which faces a little north of west, is high up on the cliff front, under an overtopping rock hood, one-fourth of a mile southeast of the point on which pictograph groups P60-P70 are found. It is on an inaccessible ledge, one hundred feet above a bench, which is itself at least seventy-five feet above the adjacent valley floor. Many parties have tried to get to it but all so far have failed; the ledge that the artist climbed over has been removed by disintegration since those remote times. The photograph here given was taken with a tele-photo lens. It is the best group of the entire series of square-shouldered drawings.

Six persons are shown, all having the square-shouldered pattern. The central figure is between nine and ten feet in height. He is carrying a large, painted shield which is suspended from his right elbow, the shield being banded and also fringed on its lower side. Back of this arm is a coiled, lightning figure. Suspended from his right hand, the hand extended above the shield, is a captured head, the neck of which shows two gashes across it which were made before it was finally severed. A concentric circular figure, probably a shield or a drum, is suspended from his left elbow. From the left hand another head appears to be suspended, though from our distance we could not be exactly sure what the object is.

To the left of the central figure there are two warriors and to the right three persons appear. The figure shown next to him on the right is that of a man who is cut out in bas-relief but the chiseling is not finished and a block of rock is still left under his arms. This per-

son's feet dangle straight downward and there are some indications that they are shackeled. A limb of a tree, with limbs broken off on the side shows back of him. From this limb he seems to be suspended apparently lifeless. A human head is suspended from the same limb, below the bas-relief figure; and below this there is a warrior who is carrying a head suspended from each hand. And to this person's left there is another warrior, drawn in large size, who is carrying a suspended head from each am. Whether he is also carrying the pole from which the head and the bas-relief person is suspended or whether it is a limb of a tree behind him could not be determined from our nearest approach.

Fig. 6. Pictograph P72. A telephotograph of a picture showing a head hunting party returning from a victorious raid. (For full explanation, see text.)

Besides being pecked and rubbed in, these figures were also painted in red, the red now showing on the shield and on the central figure's headdress.

(Below the cliff on which these pictographs are pecked on its west, there is a cave-area which could have been made a good home by using a lean-to front. The shifting sand has partly filled up the cave area, so its exact size cannot now be ascertained. The incoming debris has covered up objects left by man, if man ever used the cave, as he probably did.)

P73. (Fig. 7). Bringing the Animals up from the Underworld. This group is on the west face of a large boulder, half a mile southeast of pictographic group P72, and one hundred and fifty feet northwest of Cave 8. The successive peoples who occupied this cave probably made the glyphs. This group represents men driving various animals up a cliff, even a turtle being shown. Most of the beasts represented are mountain sheep and mountain goats. On the left side of the picture there is a maze scene, the purport of which is problematical. The whole scene probably represents, or is suggestive of, the myth of bringing the beasts up from the earth-shelf beneath us to this earth-shelf, or some similar myth, such as is acted out in a dance pageant among the southwestern village Indians each year, often as a part of the flute ceremony, or the annual animal dance, also held by many of the same Indian settlements. Pictographic group P88A, which will be described later, is a similar but apparently much older interpretation of the same myth.[7]

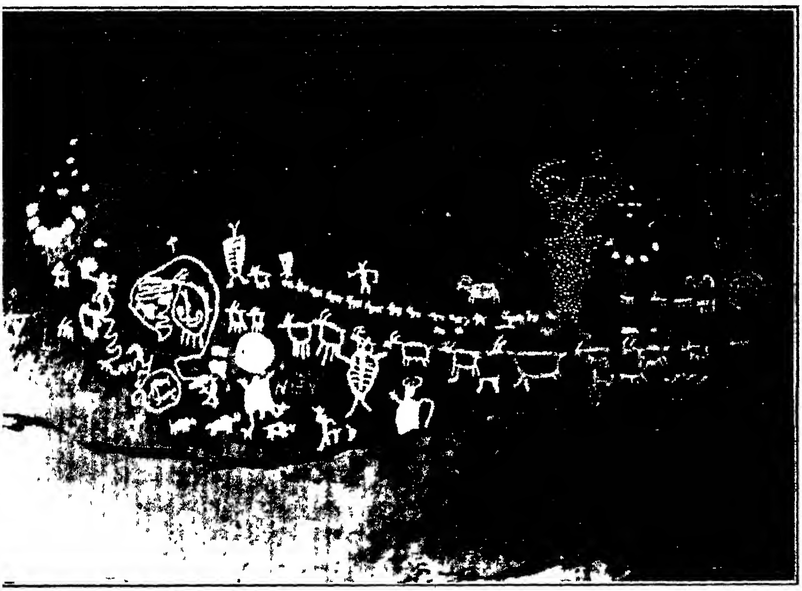

Fig. 7. Pictograph P73. Probably the acting out of the Puebloan myth of bringing the animals up from the underworld to this earth shelf.

7. In the long ago, according to one of the variations of this myth, the earth was peopled with human beings as it is now, and in addition some of the present animals were also human beings. There were no animals, fish, or birds upon the earth then; they were all created but were all in their first home in the heart of the earth, from

This drawing has its figures deeply incised. It is superimposed on two other drawings of different ages, probably representing two older cultures. In other words, three stages of culture may be represented here.

The oldest drawing is wholly made of fine holes formed by drilling with a tiny drill. In this drawing the figures of two men can be made out, one of which can be fairly well filled in by chalking the original drill holes. Other scattered drill patches show that the whole face of the boulder was likely covered with drill-hole figures which

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which man had been driven on account of his wickedness.

For a long time the people lived on the earth without the beasts, fish and birds. They had corn and fruit to live on, but soon found that it was not healthful to live without meat.

One day the chief of all the people of earth called the people together and said: "We must bring the animals, fish and birds to our earth-shelf", as he designated the earth's surface, "since we are forbidden to live where they dwell".

"We will try and bring them here", said all the people.

Otter tried to dig down to the underworld. He dug and dug till he struck a great rock and had to return.

Then Beaver tried; but try as hard as he would he only dug in a circle, so would come back to where he started.

Then Badger tried. He dug and dug till he could see the light from the world below, then also returned.

"Now", said the brave chief of the Flute clan, who loved the people and wanted to do them good, "I will go down through the whole that Badger has made and will then climb down the sky roof to where the things of that earth-shelf live." So he started to climb through the hole, taking his flute with him.

For three whole days he climbed down. Then before him there was a beautiful land. There was an abundance of soft green grass, much more than on this earth-shelf. There were groves of beautiful trees and sweet flowers of every color. There were animals and birds everywhere, and the streams were swarming with fish.

At once he realized that the people of earth had lost a paradise through their wickedness. But what was done was done. So he set about to carry out the purpose for which he had come.

Just at twilight he placed the flute to his lips and played the sweetest music that was ever heard. No sooner had he sounded the first note than all the beasts and birds began to come from everywhere. They filled the great valleys and even climbed over the mountain tops, carrying whatever they could on their backs, even great jars in which innumerable fish swam about, and they followed at his heels as he crossed the great stretch of land and climbed up the walled roof of that underworld. Up, up he climbed and they followed. Up through the great hole he climbed as he continued to play the sweet music and through it they all started to follow.

But the people of that underworld heard the noise and rushed from their homes, exclaiming: "The birds! The beasts! Everything! Everything is getting away!"

Quickly they scaled the walls of their sky and closed the hole before many of the creatures of that underworld escaped. The flute player, however, had done his work well, for the innumerable creatures we have he brought to this earth-shelf.

The myth chiseled on the rocks here seems to show that the people of Ashley and Dry Fork valleys were related to, if not the progenitors of, at least a part of the present southwestern peoples who possess the oral myth relating to the same mythical event. The "flute players" inscription on the rocks of northeastern Arizona and elsewhere probably indicate that this myth travelled toward the southwest. See Kidder and Guernsey, 1919, pp. 193-195, and Fig. 96.

time has removed. The intermediate set of glyphs were of the square-shouldered type of drawings, now represented on the rock face by the deeper chiselings of the eyes and mouth and accompanying ear-pendants of each head. The animal group is incised right over the other two groups, both over the square-shouldered series and that of the finely made drill-hole type, clearly showing the succession.

(The surface on which these glyphs are pecked is a slab-sheet which is less then two inches in thickness. The crumbling off of the bottom of the slab has already destroyed some of the figures. Its lower part should be reinforced by cement to preserve it; and, if possible, some means should be employed to prevent this sheet from shearing off the boulder and thus destroying its precious records. It should also be added that civilized men have cut their names and written them right among these pictures. Measures should be taken to stop such practices before the glyphs are irreparbly defaced.)

P74. The Wheel-Headed Woman Group. This series of drawings is on a large boulder which faces the west. It is about 300 feet southeast of Cave 8, 450 feet southeast of pictographic group P73, and almost in front (west) of Cave 9, where people probably lived who made the glyphs. Many drawings have been on this rock face, probably painted-in, for the most part, the eyes, mouth and conspicuous parts being chiseled-in before the painting was done. The woman with the vertically banded body still shows the black paint with which she was painted. Besides the figures which the writer chalked, indicating the missing parts by detached lines as far as he could make them out, eight other faces are represented by eyes and nose chisel-marks and one by what appears to have been a showy headdress in red. The rest of each drawing is now completely oblitered.

Besides the black-painted lady with the vertically barred body, the other conspicuous figure is a wheel-headed lady, with double cord skirt. The man to the right of these two women is carrying a badge of some sort, or possibly a captured head, in his left hand. The man to their left is wearing an inverted, buffalo-horn headdress. The two necklaced heads at the left of the drawing are, no doubt, parts of painted figures, the paint having been removed by weathering. The same may be said of the two figures at the right. The figure which is the farthest to the right here was superimposed on the other and, of course, was drawn at a later time. The head work of the older figure was incised by drilling with a very small drill. The figure on the split-off part of the rock is a drawing of a person whose headdress is a wheeled, open, concentric coil that was apparently never finished. All of this was probably painted. Near this person, to the right, there is a human figure with headgear that is pecked-in with very fine peckings; but the weathering of the rock here has effaced the pictograph to such a degree that it cannot be clearly made out.

P75. The Open, Concentric-Circle (Spiral) Group. This group is on a large rock-block projection that has slid off the main mesa wall which here projects westward toward the valley. It is about seventy feet southeast of pictographic group P74. Cave 10 also surrounds this rock block on all sides except its southeast front and it is quite likely that its residents were the people who made the glyphs. The area on which the glyphs are deeply chiseled faces the southwest.

Nine open("rope-coil"), concentric circles (spirals) show on the main face, and another shows on a smooth section of an offset. One of these is two and one-half feet in diameter. Besides a snake, a wheel-concentric circle, the eyes and nose of a human face and several unintelligible figures, four complete figures of human beings appear. One is of diminutive size, with a straight, horn-projecting head-ornament. This figure may represent some beast or insect. The figure next to the left is a round-shouldered person, who has his hair arranged in side locks and is wearing an elaborate mask. The figure to this one's right is a man who has very large toothed combs projecting upward from his hair and wears his hair in side locks. He presents a rear view. His right hand has been obliterated by a cracking-off of the rock. In his left hand he carries a rake-like object which is two and one-half feet in length. (High up on the rock wall between pictographic groups P60 and P70 there is a similar figure, except that the latter is not holding anything.) The upper human figure to the left has a small head and a barred body. He, too, is presenting a back view.

This group was apparently made by the same people who made the pictographs of groups P60 to P69.

P76A-B. This series is just around a point of rock, about 200 feet west of the city water intake for the city of Vernal, on Ashley creek. The space is sixty feet long by ten feet high and has been covered with pictographs at two different times. However, the first was partially weathered out before the second was put on.

(The drawings here are also different from those we have previously seen, bringing in an innovation which shows a change in the people of the region. Many of the drawings are of big-headed people with elaborate headdresses and small bodies; and this characteristic holds throughout most of the remaining pictographs yet to be considered. Another conspicuous change is that the almost life-size human figures we have been dealing with are replaced by drawings usually of a much smaller size.)

P76A. (Fig. 3). The Bear and Man Face to Face. A Bear Dance Scene. Here a bear and a man are dancing to each other. Back of the bear is a necklace of a figure that time has obliterated. Under the man is an open concentric circle and a pine tree; and back of him

there is a maze series, which was placed over the drawing of a person whose figure was all but obliterated when the maze was made.

A bear scene similar to the one depicted here is also shown in pictographic groups P8 and P41, as we have seen, except that in the P8 group the human dancer is represented as having a round body, instead of having square-shoulders as in the other two cases.

P76B. Many figures of the older series have been so obliterated that we could make out either none or only a part of them. These figures here were painted in red as were the figures of P76A; red is all that shows now at any rate, and it shows only in patches.

The central figure of this group is a little-bodied woman who is wearing a very large and striking headdress, the reduced drawing making her look like a bird in the photograph. A square-shouldered drawing of a woman is at her right. Parts of several other figures also show.

P77. This is a drawing of a man on the face of a boulder, directly over the mouth of Cave 30. It is two hundred yards south of the junction of Ashley and Spring creeks and about two miles south of the Merkley Cave (Cave 20) which is now used as a barn.

P78. This group is on the north face of a large boulder that is standing on end, off from the main cliff, about a hundred yards south of Cave 30 and pictographic group P77. It consists of several drawings of people, a worm, three trees, a snake, several freak pictures, and the figures of two men who are shown as holding hands.

(Near the boulder on which these pictographs are pecked there is a small, flattish-topped boulder on which there are six arrow-straightening grooves. On the mesa cliff wall, about a hundred yards northwest of it, there are also drawings of concentric circles, eighty feet above the valley floor.)

P79. On the lower rock face, on the side of a large boulder, about 200 feet east of P78, there are drawings of snakes, a tree, a concentric circle, and two human figures that can be made out, each of the latter being represented as wearing a peculiar headdress. The rest are freak drawings.

(High on the wall above the glyphs of P79 there are five deeply cut concentric circles, four of which are each a foot in diameter. A tree and two crude figures of men are also there, deeply cut. It is the writer's opinion that these drawings, which are fourteen feet above the valley floor, are much older than those of the part photographed. Ten feet east of this (P79) group there are two pecked-in square-shouldered figures of human beings.)

P80. The Pine Tree Group. Two trees and a man are shown in

this group. The tree to the left is represented as falling, the land surface toward which it is falling being represented by a long line. Parts of the central figures are missing, due to wear, as is practically all of the human figure back of them.

P81. Another Tree Group. Evidently the Pine Tree clan of some tribe lived in this section. Two pine trees and a worm are the conspicuous objects of this picture. Above the trees is the body of a man, beneath which there are seven parallel, perpendicular bars, each four inches in length.

(A round-bodied figure of a person is pecked on the cliff face about midway between this group and P80, the former group being forty feet southeast of the latter.)

P82. A Bear-Track Series. This drawing is on a large boulder, a hundred feet above and about one hundred and thirty-five feet east of P81. Five tracks show, as does the figure of a man, with his hair represented as standing on end, probably illustrating the ancients' belief in the power of the bear shaman.

P83. This group is on the east face of a boulder, halfway up the cliff side, one-fourth of a mile south of P82. It is also about a hundred feet west of the main cliff wall. Five adult goats and a kid are here shown. A man who is somewhat above them and who is wearing his hair in side bobs, or side locks, is shooting at one of them with a bow while in front of them is a coyote. Under the goats there is a peculiar figure which is lying down and has three enormous combs for a headdress(?). A man is standing to the right of the lower comb and to his right there is a weir-affair. Above it there is a coiled lightning symbol.

Under the ledge on which the above drawings were made there are figures of three women, with barred apparel.

P84. (Fig. 3). This is a glyph of an ancient fish trap. The up-extending parts were the dam across the stream and the part below the dam was piles of brush in the stream, about which there were side-pocket contrivances to catch the fish that escaped through the central hole in the dam.

P85. (Fig. 3). A Head Hunting Scene, or the Man with the Big Hands. The only figure here is that of a head hunter who is returning with a human head. About him are the hand prints of the victim which he left in his struggle in trying to escape, we would suppose. It is noticeable that this victor is wearing his hair in short side bobs.

P86. This scene, which is ten feet east of, and on the same part of the boulder as P85, is probably a part of the same scene. Besides several much worn figures of human beings, three complete figures are shown. One of these is represented as having been thrown off

the cliff by his fellows. It should also be noted that the principal actor had his hair done up in side bobs, or has it cut a little below his ears.

P87. Besides the five circles which may be heads of unfinished drawings, two of which have big mouths, and two, eyes, mouth and neck each, there is seen high up on the wall a square-shouldered man of about half natural size. Near him are the eyes, mouth and ear pendants of a square-shouldered personage of large size, the outline of whose body is now all but obliterated. As we had no ladders with us at the time and the last two figures were so high, the latter were not included in the photograph.

The central upper figure of the lower group is that of a man wearing a bird for a headdress. The figure at the left of the picture is not masked and is probably the man of ceremonies. This man attracts notice in that he is wearing his hair in side bobs. One man of the group is wearing a buffalo skin with horns for a headdress. Another has a horned headdress which extends from his head on each side in comb fashion. There are three other human beings that are masked to represent some beast or insect. The whole group probably is an animal dance scene much like the animal dance scenes that can be observed in the Southwest at the present time. And again it is quite possible that it is an imagery death-dance scene, similar to those described by Kroeber (1925) as held by the Maidu (pp. 431-432), the Kawaiisu (p. 609), and the Kitanemuk (p. 613), the circles being crude images of the dead people for whom the ceremony is being conducted.

P88A-C. Bringing the Animals up to this Earth Shelf from the Underworld. This series, which is fifteen feet long by twenty-nine feet high is on the main mesa wall, about one hundred yards due east of Pictographic group P87. It is one and 1-4 miles down the canyon of Ashley creek, due east of pictographic group P73, the other scene of bringing the animals up from the world beneath this one. It, too, is 250 feet above the valley floor and its base is twenty feet above the table-top of the adjacent talus slope. It is the writer's belief that it is a much older drawing than that of P73.

P88A. The Main Group of Bringing the Animals Up from the Underworld. The conspicuous person in this group is a man carrying a very large drum on whose exposed face is a drawing of the sun, and from which there is suspended a tassel-coil. The drummer is further made conspicuous by the way he has his hair done up in side bobs, one of which projects strongly outward over each ear, and by his wearing of large rattles which are suspended from his legs near his ankles. The other musicians of the group are two diminutive flute players, one of whom is humpbacked. The latter, who is far out to the left, is not represented as holding the flute in his hands.

The other flute player is situated more centrally in the lower group and is characterized by having four tassels floating backward from his head. The flute, which is represented as having five holes, is held in his hands, as he plays on it. Another humpbacked man is shown at the extreme left, but there is nothing to indicate that he is playing a flute. This is the first time that we have found flute players represented as standing up. At all other placcs where they are depicted they have been shown as lying on their backs. However, they are shown as humpbacked, as were those chiseled on the rocks of Northeastern Arizona. (See Kidder and Guernsey, 1919, p. 195, and Fig. 96.)

Eight other men men are shown in this scene. One has very big hands and feet; and another a very elaborate head ornament which projects upward and outward from above each ear. This latter person is also represented as shedding immense tears; he is probably the overseer of the underworld and is peeved at the loss of the beasts from his domain. The man with the big hands and feet has a comb-headdress. The others are wearing their hair in side bobs like those worn by the drummer, though more or less modified. One man in the middle foreground and the two together at the extreme right are carrying captured heads, probably for sacrificial purposes.

(High up on the rock wall there is a concentric circle drawing which is ten inches in diameter. A closed concentric coil is shown and the zigzag lightning is represented as shooting out in six directions from a common center. The drawing probably represents the six cardinal directions, from the Indians' point of view. As these groups were too high to be chalked in they do not show in the photograph.)

Besides several unintelligible beasts, one can make out an owl, probably a duck, mountain goats, mountain sheep, coyotes, and snakes.

(It is possible that this series of glyphs (P88A) and that of pictographic group P73 are records showing animals being driven into traps or boxed canyons, where they could be more easily slaughtered..)

P88B. This group, which is a continuation of P88A, is to the right of the man with the big drum in that scene. It is on a rock face at right angles to the rock face on which the former is drawn. Its main figure is a large footed, large handed man, below whom there is a crude figure of a human being. The other figures of this group are unintelligible. It is noticeable that both men represented are wearing their hair either in side bobs or as cut off just a little below the ears.

P88C. (Fig. 2). Ten feet up the rock wall, forty feet east of P88A there is a drawing of a goat and a big footed man. As in the other sections of this series the man has the same style of hair dressing, that is, he has his hair done up in side bobs.

(Below this drawing, just above the talus slope there are drawings of goats and mountain sheep. It is the writer's opinion that the series originally extended all the way down the cliff wall to this scene, the wear of the elements having effaced the connecting part.

P89A-D. A Hunting Scene. This series, only a part of which was caught by the camera, is sixty feet long by twenty-four feet high. It is above a ledge-shelf on the same rock wall, about 200 feet eastward from series P88A-C.

P89A. This is the west section of the series. Several mountain sheep and goats, a pine tree, a feather(?), and several peculiarly shaped drawings, apparently representing rain clouds, are shown.

P89B. In the upper-middle areas of this group there are trees, an open coil, and a closed, concentric coil. Near these a man is being shot off a cliff by a partially concealed enemy, while several mountain sheep are represented as looking on. Above these, to the right, there are mountain sheep, two incomplete figures, and the figure of a man who is wearing ear pendants. Higher up in the center of the drawing there is a man who is wearing a headdress on which a tree branch extends divergingly upward and outward from above each ear. Other tree branches are shown near at hand. The upper figures of the group are forty feet above the talus bench and could not be reached and chalked-in, though we spent nearly a whole day on this one group.

Below the last figures mentioned above, there is a pecked figure of a human being who is represented as wearing a divergingly tasseled headdress, above whom there is a mythical, coiled figure, with added streamers. To the right of this last figure there is a large footed, large handed man, with diverging, comb-like projections, projecting upward from above each ear. Immediately below this figure there is a large snake. And below these a hunting scene is depicted.

In this latter scene five mountain sheep are shown almost in a row. One hunter is shooting at them from above and four from their rear. The bows and arrows show distinctly in the drawing. Below this group two men have attacked an elk with bows and arrows, while another man is throwing stones at it over a cliff. A man is also shown shooting at a big elk at close range from its rear. A characteristic feature of this whole group is that the hunters are all shown in striking poses.

P89C. This group is below and to the left of the P89B group. Twenty-five mountain sheep and goats are shown in addition to a pair of human eyes and a mouth, a probably mythical being, and the figures of three men, one of whom has his hair done up in side locks?. One of the men is represented as preparing to shoot a goat with an

arrow, and another appears to be trying to coax a goat to come to him by offering it some tempting morsel.

P89D. This group is between the boulders, below but still on the same rock face as P89A-C. Besides a concentric circle and two goats, we see a man who is concealed behind a boulder and has shot another man who is falling headforemost off a cliff.

P90. A pair of hands are here shown.

P91. Forty feet farther to the east along the same wall on which the hands of P90 are rubbed, there is a drawing of a mountain sheep, and a very peculiar drawing whose purport is unknown.

P92A-B. This series is above a bench, forty feet above the talus slope. It is on the west face of a cliff, 125 feet east of the pictographic series P89A-D.

P92A. This group consists of a single figure and of two figures, one superimposed on the other. These glyphs are all drawn in large size. They are also somewhat square-shouldered, but not typically so. The large superimposed drawing has hands and feet, the under figure being handless and footless. The single drawing has feet but is without arms. Like all the people whose drawings are depicted in this vicinity, they are all shown as wearing their hair in side bobs, which in these drawings, as in many others, are represented as projecting outward from the side of the head over the ear.

The single man of this group is carrying a head. A headless man is shown in this group and also in the next, P92B, neither of which are shown in the photograph.

P92B. This group is considerably weathered. However, the figures of twelve human beings, somewhat similar to those of P92A, though much smaller, still show in whole or in part. Some of these men are also shown as wearing hair bands and as having their hair cut off straight across, a little below the ears. Two concentric coils, two human hands and a long horizontal line of a zigzag lightning snake are also shown, the lightning figure being drawn above the heads of the men of earth.

(The glyphs of pictographic groups P89A-D to P92A-B, do doubt, were made by the Indians who inhabited the two caves (Cave Group 31) which are higher up on the cliff wall, an eighth of a mile to the eastward.)

P93A-C. The Maze-Parade. This series is on a boulder, on the edge of the valley, about a fourth of a mile southeast of pictographic groups P89A-D to P92A-B. The main series divides itself into two sections, both of which are maze groups.

P93A. The Upper Maze Group. This group is almost wholly a maze. A coiled lightning figure, a crude figure of a man, two snakes,

and a goat, make up the rest of the scene.

P93B. The Lower Maze Group. This exhibits a parade and also a very extensive and complicated maze. There are pictographs of men, snakes, goats, a scorpion, several human foot-tracks, a woman with a hobbled skirt, a square-shouldered man, a large goat, and two concentric coils. Besides, these, five men who are holding hands are represented as marching, the foremost two carrying a very much beflagged, high standard.

P93C. This group is on an upright, adjacent boulder, which is to the north and at right angles to the face of the boulder where pictographic series P93A-B are pecked and rubbed. It shows a snake, a mountain sheep, and one man holding another.

(On the face of the boulder on which the mazes are drawn, in the space between it and the boulder on which P93C is pictured, there are several pictographs. Two of these are of blow-adders, wih head thrown up for blowing. A bull snake and a goat are also shown.)

P94. This group is on the southeast face of a house-sized boulder, at the valley edge of the talus slope, a quarter of a mile southeast of pictographic group P93A-C. The pictographic area here is twenty feet above the ground, the ledge on which the artist stood being now mostly worn away.

The central, upper figure of this group is a fawn, a figure that is superimposed on other figures and consequently was of a later production. Besides a small concentric circle and several drawings which are now so worn that they could not be made out, there are partial figures of two men, the rest of their figures having been worn away. The figure to the right has had a very elaborate headdress, only part of which is now clearly shown.

P95. Another Man Hurled Off a Cliff. Besides a worm (or a worm's track) two men are represented, one of whom is falling headforemost. It has been suggested that the so-called worm tracks represent the course of the men tumbling over the cliff.

P96. This group is on the main mesa wall, one mile south of the Maze-Parade series P93A-C. Five crude drawings of men are shown. The two right-hand figures are much worn; and a part of the headgear and the arms of each cannot now be made out.

(Three hundred yards north of this group there are several pictographs, now so worn that only a necklace and a part of the head of its wearer can be made out.

About halfway between this group and the series P97A-B, next to be described, there is another drawing of three peculiarly constructed circles, near which a warrior is shown.)

P97A-B. This series is high up on the cliff wall, about forty feet south of P96.

P97A. This group consists of a small maze, five concentric circles, the imprints of several human hands, some peculiar, parallel, winding lines, and two, much headdressed dancers.

P97B. Besides several crude figures and a start at the making of a pine tree, this group contains the figure of a large sized man who is of the square-shouldered type and is wearing side queues over his ears.

A piece of the rock ledge has fallen and on the fallen slab a mountain sheep, a goat, and a man are shown, the latter also having side-hair queues.

P98A-D. This series is low down on the cliff wall, seventy-five yards southeast of P97A-B. It covers a space one hundred feet in length and in places is twenty feet in height. In places there are three parallel series of drawings, one just above the ground, a middle and an upper series.

(The cliff wall here is more or less pitched over and this site was, in all probability, a cave camp site in the olden times, the shelters being made as lean-to's. In the days of civilized man the site may have been used by sheep herders, but there is no evidence that they did so use it. In recent times cattle have corralled themselves about the site.

The lower and middle series of drawings seem to have been tampered with in places, or they were made as a pastime, it would seem. Some drawings have been recently made, one of which is that of a man riding a horse. The peckings of these are fresh and consequently we did not chalk them in. All the upper drawings are undoubtedly ancient and were made by trained people. They are now much worn, only necklaces, eyes, and noses being shown in some cases.)

P98A. The necklace, eyes, and mouths, not the big square hat(?) of this group are ancient, the body and head outlines being weathered out. Three other necklace drawings also belong to very ancient figures which time has effaced. Aside from a pair of feet, the rest of the drawing is an unintelligible maze.

P98B. (Fig. 3). This group shows a mallet, a hooked-shaped war club, and a plummet-shaped instrument, all most likely being instruments of war.

P98C. High up on the rock wall of this section there are the remains of a square-shouldered(?) human figure which was not chalked in, as its outline is so worn that we could not make it out. In the middle series, two men and a wolf are shown. The men are carrying rainbow symbols (or hoops to be used in the hoop-pole game, though

they seem to be too large for that use). The lower figures that can be made out are three men, an open coil, and an elk.

P98D. In the upper series of this group there are represented five human beings. But these figures are now so worn that we did not chalk them in. Besides these and the figure of a duck, a deer, and a circle which probably represents the sun, there is a partial drawing of a mythical beast. In the middle series, a coyote, two mountain sheep, an antelope head, human foot tracks, bear tracks, the tracks of some cat-like animal, flat-leaved cactus leaves, and several crude figures of men can be made out. The other various markings and lines are unintelligible.

P99-P105. These glyphs are all along the Rock Point (Mesaverde) outcrop between Camp Sites 3 and 4, just north of the Rock Point irrigation canal, northeast of the main Ashley creek, north of Vernal. The linear distance from east to west from the western end of this rock-outcrop to Steinaker draw, as far as seen by the writer, is a little over two miles. The writer would also judge that this outcrop is four or five miles south and somewhat east of pictographic series P98A-D, just described. The rocks here are pitched south-southeastward at a considerable angle. As a rule they are rough surfaced, but there are occasional smooth spots which are suitable for pictographic writing, all of which are covered with ancient pictures.

P99. This group is at the westernmost point of the Point of Rock reef here. Besides several other drawings, a woman is shown wearing a skirt.

(Quite a number of other drawings show on the rocks in this vicinity, some having been painted in red. A cave, a little higher up on the opposite side of the same ledge, shows eleven figures that were painted in red; but they are all too badly weathered to be made out. Forty feet above the group photographed there are several figures in red, similar to those in the cave just mentioned; and these, too, cannot be clearly made out.)

P100A-B. This series is on a boulder just north of the Rock Point irrigation canal.

P100A. The Skunk Group. Two skunks are here shown, as are three large, square-shouldered men who are partly superimposed on each other. A figure to the right of these is now incomplete, due to weathering. A hand shows at the extreme right. At the extreme left, what is probably a group of cactus is shown, beneath which there is a striking snake. It is attacking two turkeys and, from the foot tracks they are represented as making, they are badly scared. Other foot tracks seem to indicate that the snake has also swallowed a turkey. A smaller snake is shown as the lower figure of the group.

P100B. Sixteen stick-men are shown in this group, thirteen of whom are carrying an object.

P101. This group consists of three figures, partly superimposed on each other, all of which were originally painted in red, over a pecked outline. However, they are so weathered that only a part of each can now be made out. The lower figure is carrying a head.

P102. (Fig. 2). Here the south face of a boulder has been smoothed by rubbing. Then at least five human figures have been outlined on it by pecking and rubbing, the outlines of two figures of which can now be made out. One of these is the figure of a woman who is carrying a cradle on her back; the other, that of a man who has double-triangular legs and is wearing nine feathers in his hair.

P103. Two actors are here represented as wearing buffalo-head dresses.

P104 and P104 1-2. (Fig. 3). This group is three-fourths of a mile east of P103. Here under an over-towering rock cap, in a little side canyon which runs north and south, there is a drawing of an Indian in bright red, P104 1-2. He is holding in his right hand a rake-like instrument which looks as if it might be an exaggerated rubbing stick like those now used by the Utes in the bear dance ceremonies. He seems to be carrying a head in his left hand. He is also conspicuous in having very large side trumpet-shaped head-tassels, each sixteen inches in length. There are many other painted figures here, which time has so obliterated that only paint blotches now show.

On this same rock front, figures of deer, sheep, goats, antelope, and elk are pecked. A strutting turkey gobbler is shown at the left; while several other turkeys are shown near the upper right margin.

Some one has shot up this scene with rifle balls, the painted figure having had six rifle balls shot in it.

P105. This group, among several others, is on the cliff wall, on the east side of the gap where Steinaker draw cuts through the Mesaverde Point of Rock reef, about a mile east of P104 and P104 1-2. It is sixteen feet above the talus slope and forty feet above the level of the valley. In it there are three men, a woman, and something that looks like a goblet. The side of the dotted, trumpet-shaped horns of the headdresses of this group still show the red paint.

REMARKS ON THE PEOPLE WHO MADE PICTOGRAPHS

The pictographs show that at least four different peoples somewhat successively held the region; Basket Makers, earth-lodge, Pueblo peoples, people of the round-bodied drawing era, and head hunters, or people of the era of square-shouldered drawings. These people are discussed in the following pages.

BASKET MAKERS

No true skeletal basket maker remains have so far been found in the region. Yet that the people here considered were Basket Makers there is no doubt. Their pictographs are the oldest; for at no place are they superimposed on the glyphs of the other periods, though pictographs of at least two cultures are often superimposed over them. Some of the photographed glyphs of this series are P39, P49, P60-70, P75, P78, P80-90, P92A-B, P93C, and P97A-B. Of these numbers P86 and P92B show men with their hair cut a little below their ears; numbers P69, P75, P85, P88A-C, P89C-D, P92A-B, and P97A-B show people wearing their hair in side locks, or side bobs; numbers P39, P49, P60-65 are figures of men, animals, suns, stars, zigzags, triangles, and the like; numbers P67 and P75 have coil and spiral figures predominating; numbers P78, P80, P81, and P89 have trees, the latter also exhibiting a rain cloud; and P84 shows a fish trap. The last four groups will not receive further mention, except to say that they somewhat resemble the pictographs of the Chumash, Gabrielano and Yokuts lands in California, which Kroeber (1925, pp. 936-939, pls. 82-83) believes are of Shoshonean origin. He states (p. 937) "The inference is therefore strong that these peoples (the Shoshoneans) are mainly responsible for the painted and carved rocks of California, in part through the work of their ancestors' hands and partly by their influence on their neighbors."

Hair Cut. The men of the groups cited are shown wearing their hair cut a little below the ears. Among most if not all of the western Indians, when first met by white men, such a cutting of the hair was a sign of mourning. The upper right figure of Plate 64 of Kroeber's work shows a mourning Mohave man. The Indians depicted here wear their hair in much the same style as he, except that in the present case the Indian is shown as wearing a hair band.

Kroeber further states in his bulletin that the Atsugewi (p. 316) cut the hair in mourning. In another place in discussing the Juaneno (p. 642) he says: "As in all parts of California and nearly all the regions of America, the hair was cut in sign of mourning, the length removed being proportional to the proximity of kinship or degree of affection." In describing the customs of the Luiseno he further states (p. 675), "He (the Luiseno) wails for days for his kin, cuts his hair, and shudders at their mention, but lavishes his wealth in their memory". He also says (p. 598) that the Mohave declare that the Chemehuevi men have worn their hair in the peculiar style characteristic of themselves and the Yuma. As the hair dressing depicted on the rocks is like that of the Mohave man pictured by Kroeber (above), with the addition of a hair band, it would seem that the early peoples of this region were ancestors of at least a part of the

present Southern Paiute-Chemehuevi Indians. The hair bands also call to mind a Modoc mode of hair dressing, as described by Kroeber (p. 327), "a crownless cap of tule for men recalls the eye-shades of rawhide sometimes donned by the plains Indian".[8]

Side Locks or Side Bobs. Eleven pictographic groups, ten of which were photographed, show this style of hair dressing and nine groups show square-shouldered drawings of human beings.

In writing of the Mohave style of hair dressing Dr. Kroeber (1925) says, in part (p. 729): "The hair is sometimes tied up in clay mixed with mesquite gum, to stain it black and make it glossy or plain clay is allowed to dry on it in a complete casing and left for a day or two in order to suppress parasites". Furthermore, as we have already seen, he states (p. 598) that the Chemehuevi wear their hair in a style similar to that worn by this same tribe of Indians.

Concerning the pictographs here, copies of which were furnished the Bureau of American Ethnology, Dr. M. W. Stirling, chief of that bureau, says; "It has been found that mummies of men found in caves occupied by prehistoric peoples have had the hair dressed in such a manner that a short braid hung down on each side in the fashion suggested by the pictographs". And in a more recent letter, he says, "The mummies found in the caves were Basket Makers". He further says in this last communication: "The glyphs shown in the photograph (P92B) which you sent are like those which are attributable to the Basket Makers.[9] The first refers to the glyphs which show people wearing side locks or side bobs; and the second refers to those glyphs which show people wearing their hair cut just below the ears, the hair being held in place by a band in the latter cases.

A scalp with hair dressed in much the same style as the people with the side bobs are here depicted as using, "the brow tresses on either side are gathered together with a wrapping of apocynum(?) string", is described by Kodder and Guernsey. (1919, pp. 190-192, pls. 87, 88, 97A and 100; and 1921, pp. 52-53, pl. 19.) They state that the head from which it was taken was presumably that of an enemy of the Pueblos. In further comment they add that in what are apparently Basket Maker pictographs in the "Monuments" and in Grand Gulch, in southern Utah, some of the figures are represented as wearing side bobs very much like those of the present specimen (those of the scalp above). They also state that these peoples pictured themselves on the mesa walls in square-shouldered drawings.

Dr. Kroeber (1925), in writing about the basketry of the upper San Joaquin valley in California, also makes remarks about the Basket

8. The Utes here have a tradition that since they came to this region the Indians from east of the mountains have made raids into this valley, and that, since the advent of the horse, battles have been fought here both with the Sioux and Blackfeet.

9. Personal communications of October 31 and December 1, 1930.

Makers of Grand Gulch (p. 934), as follows: "The same as had been said about a wooden 'potato-masher-' shaped war club) may be said of a number of bags twined in basketry technic but of soft string material . . . . These are similar to the bags and wallets made by the Diegueno and Mohave, and bear an especial likeness, at any rate superficially, to utensils of the so-called 'basket makers' who once lived at Grand Gulch, in Southern Utah."

From this one would be led to believe that the people who depicted their likenesses on the rock walls here as wearing their hair in side locks and side bobs were the so-called Basket Maker people. From the foregoing it can also be reasonably concluded that, as previously stated, they were also of the Shoshonean family and probably the ancestors of at least a part of the present Southern Paiute-Chemehuevi, who in some way seem to have been somewhat influenced by the Mohave peoples of that far off time.

It does not seem possible that the ancient Mohave people, once extended their domains as far north as this and that in the years that have come and gone they have been gradually pushed southward by the Ute-Chemehuevi. It would rather seem that the latter have pushed into Mohave territory so much that portions of each have been absorbed by the other, thus accounting for the fact that the two tribes now have similar customs. Since the people of the side-bobbed hair here were makers of rock pictures, this supposition is further strengthened by the fact that the Southern Paiute-Chemehuevi are of the Shoshonean rock-picture making people, while according to the literature that the writer has seen, the Mohave were not

From the glyphs here described it would seem that several clans of these people were represented, as a sun, a moon, a pine tree, and a snake clan. The drawings also show that there was occasional strife. For pictographic groups P69 and P86 each shows a man being hurled off a cliff, P89D shows a man being shot from ambush, and P92A and P92B each shows a decapitated body. P70 also seems to show that a Basket Maker head is about to be sacrificed, apparently to an enemy captor. On the whole, however, they seem to represent days of peace in a land of plenteous game, hunting being depicted as their principal occupation.

THE EARTH-LODGE PUEBLO PEOPLES

The undoubted, recognizable pictographs that these people left in the region are pictographic groups P3A-F, P4, P39A-B, P53, and P79. There were undoubtedly others but time has effaced them.

P3A-F is the most extensive series of pictographs left by any people as far as we have seen. This series and pictographic group P79 much resemble the pictographs, and especially pictographic group

N-P17, in Nine Mile Canyon, sixty miles to the southwest. The latter were undoubtedly made by Puebloan peoples, as the forts, towers, and cliff-houses of these people extend up and down this canyon from one end to the other. The pictures here also show kachinas dressed and performing very much as kachinas dress and perform in Pueblo-Hopi ceremonies of the present time. An image of the horned (or plumed) snake is being carried about here as it often is carried in certain Pueblo ceremonies. Conventionalized objects, such as corn, are also shown much as they are depicted in the ceremonial paintings of the Hopi-Pueblos and in the sand paintings of the Navajos, though, of course not exactly the same. Furthermore, these glyphs are entirely different from any other glyphs which were made by the people who preceded or followed their makers in the region. P4 goes further and shows "watchers of the water jar" dressed in clothes much as are now worn by Pueblo and Hopi maidens on gala occasions. P53 shows a maiden with whorled hair, only one whorl of which we were able to make out, due to the wear of time. But if we are still in doubt about their being pictographs of, or made by Pueblos, the two groups of P39A-B settle that, for here two women of the older drawing are positively shown with whorled hair, worn exactly as Hopi virgins wear their hair at the present time; and the wearing of such whorled hair by Puebloan maidens is depicted on the rocks in the Navajo country and elsewhere, as we have seen. And on this ancient petroglyph there is superimposed a square-shouldered drawing that was made at a much later date, by the people who finally expelled the Pueblos from the region.

These pueblo peoples were peaceable and at no place do they portray any strife. Theirs seems to have been a happy land where, judging from the glyphs they left, there was an abundance of game; and their irrigating ditches that can still be traced indicate that they had bountiful fields. Theirs, for their day and time, was a paradise. Then there came troubled times, and they must have been swift in their coming. The records of these times were left by their enemies who depict themselves as bringing home the heads of the Pueblo braves and as leading their women and children into captivity, as will be given later in another section. As their earth-lodge pueblo remains show that they did not advance beyond the Class A type dwelling stage of Pueblo I Horizon in the immediate region, nor beyond the beginning of Pueblo II horizon in any of its environs, as defined by Roberts (1930, pp. 65, 66, 71, and 73), all these events occurred probably before the beginning of our era.

PEOPLE OF THE ROUND- OR CIRCULAR-BODIED DRAWINGS

These people who patterned their drawings after the visible, round face of the sun and moon, it would seem, were dwellers in a part of the region at a time when the Puebloan peoples were not strong

enough to drive them out. Furthermore, judging from the drawings they left, they must have been at peace with each other. At least the glyphs so far seen show no sign that there was any strife between less in the case of pictographic group P17, and even here the older picture is so old and so effaced that we could not make out enough of it to determine whether it was Puebloan or the production of an earlier culture.

Since the time when these round-bodied pictures were first noticed by the whites, sixty odd years ago, the general belief held that they were glyphs of pregnant women; but a careful study shows that they were not drawn in circular form to indicate that condition, as both men and women are represented in the drawings, the women having their breasts represented by a circle or a circle within a circle. On the other hand, as stated above, this series of drawings undoubtedly represent a culture that was intermediate between the balmy days of the Pueblo peoples and the days of war that were ushered in by the coming of the people of the head hunting, square-shouldered drawing era.

The glyphs that these people left, as seen by us, are groups P6, P8, P12, P17A-D, P19A-B, P23, P36, P40. P43, P48A-D, P51, and P52, Of these P8, P17A-D, P19A-B, P36, and P51 have square-shouldered drawings superimposed on them, showing conclusively that they were made at a much earlier date than the square-shouldered ones.

A peculiarity of this series of glyphs is that the human heads are usually represented by somewhat squarish or angular drawings, generally without the hair or any ornamentation being shown, though the central figure of P17B shows an elaborate headgear. Necklaces which are so striking in the square-shouldered drawing era that follows, practically do not occur at all in this series.

That the people who made the glyphs were of the Ute-Chemehuevi group of the Shoshonean family as given by Kroeber (1925. Fig. 52) there seems no doubt. It would also seem that they most likely belonged to the ancestors of the Chemehuevi part of that group. That they were ancestors of at least a part of the present Ute-Chemehuevi is settled beyond question by pictographic group P8, which shows a bear dance with a round bodied man pictured as dancing to a bear, even the resonator (an inverted basket) and the bear rubbing sticks being shown. Just so it is now pictured and acted by the Ute Indians, except that the human dancer is drawn according to the round-bodied pattern. A flag with a painting on it of a man dancing to a bear is hoisted over the west side of the bear corral, over the drummers, at every dance of today, as has been previously mentioned. And the view here portrayed in P8 has a head-hunting scene of the square-shouldered era superimposed on it. Furthermore, as it was the square

shouldered peoples who finally drove out the Pueblos from the region while they were yet in the culture stage of Class A type of dwellings of Pueblo I horizon, we are again probably looking on scenes which occurred before Caesar crossed the Rubicon.

THE PEOPLE OF THE HEAD-HUNTING SQUARE-SHOULDERED DRAWING ERA

The glyphs left by these people are the most numerous in the region. They are also found superimposed on the glyphs of each of the other cultures, thus showing beyond question that they are the latest in the time scale, of the hundreds of pictographic groups of this era that we saw we photographed fifty-four. Of these numbers P8, P10, P17A-D, P19A-B, P30, P36, P39A-B, P53, P74, P76A-B, and P104 are superimposed on the drawings of the previous cultures; and numbers P8, P10, P15, P19A-B, P20, P30, P33A, P34A, P35, P51, P70, and P72 are head hunting scenes.

Four of these groups, namely, P35, P39A-B, P41 and P76A interest us more than the others do. P39A-B shows drawings of the square-shouldered, head-hunting drawing era superimposed over the drawings of Pueblo women who are shown as wearing whorled hair as Hopi virgins wear their hair at the present time. Group 35 goes further and shows similarly attired Pueblo women being led into captivity by a head hunting party of square-shouldered warriors who are also returning with the heads of the braves who dared oppose them. These two groups undoubtedly establish the fact that the Pueblos antedated this square-shouldered people and that it was this same people who finally drove them from the region. Pictographic groups P41 and P75 conclusively show, on the other hand, that the people who made these square-shouldered drawings were Shoshoneans and also Shoshonean ancestors of the present Ute-Chemehuevi Indians, if not of the Southern Paiute-Chemehuevi division of that group. For here a bear dance scene is depicted almost like that still portrayed on the bear-dance "flag" that is hoisted over the west side of the bear dance corral on every dance occasion in the Uintah Basin lands. P41 even shows a fallen, exhausted dancer such as is seen usually when the bear dance becomes an endurance contest. P27A also seems to be a similar endurance contest scene. Yet since the same scenes depict Pueblo people being held captive, we can readily place this dance as having occurred two thousand years ago.

It was noted when taking up the individual pictures that pictographic groups P8, P27A, P30, P32, P33A, P35, P41, P48B, P56 and P70 showed people with slant eyes. Observers have concluded that these slant eyes were so drawn to represent people as crying. But we cannot imagine why the returning victors should be represented as weeping. However, a case or two might be so construed. if we would

conclude that in group P34A, for example, the parties are bringing back the heads of their own people which they have recaptured from an enemy that had raided their lands. But it is the writer's opinion that such an event would not be pictured, even if the glyphs did show such, which they evidently do not. It is the writer's opinion that all the head hunting scenes portrayed are, in each case, the returning of a victorious war party, bringing back with them both captive women and children and the heads of the braves who dared defend their homes.

Is it possible that the slant eyes depicted show that in that far off time there was an influx of slant eyed people from Asia and that time has so absorbed them that the slant eyes have ceased to exhibit themselves in our day, though oriental faces are now and then noticeable, especially among the western tribes, at least faces that occasionally have an oriental suggestion? And is it possible, too, that the round headed Pueblos are, in part, descendants of these peoples, the shape of the head still remaining but the slant eye having passed out in the revolving years that have elapsed? If such should prove to be the case our glyphs would show that the slant eyed people were intermarried with both friend and foe, as some of the captured heads as well as some of the victors show the slant eye.

Photographs of these slant-eyed glyphs were sent to the Bureau of American Ethnology, bringing forth the following comment from that Bureau's chief, Dr. M. W. Stirling:[10]

"The peculiar eyes are probably due to the effort to depict a group which painted their faces so that they emphasized the eyes in that fashion. Many of the masks used by some of the pueblo groups have long triangular figures extending from the eyes in just such a manner."

We can see that the victors might emphasize their eyes that way, but it is hard to see why the heads of the vanquished should be similarly shown, as it is very hard to see why their eyes should be emphasized or would be emphasized by their captors. And again that the Pueblos use masks with long triangular figures extending from the eyes in some manner would probably hark back to a time when there were people on this continent, possibly a strain of their ancestors, who were actually slant eyed. However, a conclusion in the matter cannot be made from the data at hand.

In ornamentation, no pictographs show nose ornaments. In numbers of necklaces and gorgets they excel any other Indians we have record of, it would seem from the glyphs which they left. The same may be said of the striking headgear which was both elaborate and

10. Personal communications above cited.

gorgeous. Squarish hats are shown in P8, P16, P19A-B, P22, P25, P27A, P34A, P35, P36, P37, P41, P76B, and P93B; and the P17A-D group shows a double-decked, or side crested, yet squarish hat. A few caps of the subdued, probably basket, California type are also shown, as in P7, P25, and P34. At the present time nothing further is known along these lines. (See Kroeber, 1925, pp. 591, 595, 654, 698, 700, and 807.)

The war implements used by these people were bows and arrows, clubs, mallets, notched war clubs, stone dirks, knives, ropes(?), and a plummet-shaped instrument.

The latter device, the plummet-shaped instrument, was apparently a perforated rock or a piece of wood, which was suspended on a rope and was most likely used as a sling-shot, but it was of large size, as in pictographic group P98B, where it is shown with a mallet and a hooked war club. It might be possible that the artist was attempting to depict something like the Southern California and Pueblo type of war club, which was a rather short, stout stick expanded into a longitudinal mallet head, with a pointed end extending beyond the mallet part. In this form it was an instrument which could be used both in down-right clubbing for skull-breaking, and for prodding the opponent's face. From its shape, if it was a solid handle and mallet combined, it could even have been used as a spear. (See Kroeber, 1925, p. 845.)

These people seemed to have strings of money, at least P31B seems to show a man exhibiting two strings of large beads. There are several other glyphs which possibly may exhibit strings of such beads. The glyphs throw but little light on the mortuary customs, either of these people or those of other cultures. However, pictographic group P34B would seem to show us a cremation scene, probably somewhat like the Mohave cremation scene pictured by Kroeber in Plate 69. The glyphs also seem to show that these people sacrificed to idols. At least one would judge that pictographic group P70 represents a shaman preparing to sacrifice a captive Basket Maker head to an idol. Otherwise, judging from the glyphs, they seem to have been worshippers of the sun, moon, (stars), snake, and the rainbow, the latter being drawn in a complete circle, as the Apaches still believe it to be, using four differently colored, large hoops to represent it in their ceremonies. (See Reagan, 1930b, sec. 22, p. 325, and sec. 24, p. 326.)

One only needs to examine the glyphs that these people left to see that they were head hunters. However, the heads were likely only trophies of war as were scalps among many other American tribes. This custom also seems to ally these people with certain Shoshonean tribes of California.

In speaking of this custom of the Juaneno, Kroeber (1925) says, (p. 647), that no quarter was given in war and that any wounded who could be seized were decapitated. In speaking of the Chemehuevi he further says (p. 728) that they were profoundly influenced by the more dominant Mohave who were their neighbors. Then in writing of the Mohave when at war he states (p. 751) that the conflict often ceased when one or two of the enemy had been slain and their heads secured as trophies to be scalped at leisure; and in speaking of warfare throughout California in general (p. 844) he further states: "A fallen foe that could be operated upon in safety and leisure was almost always decapitated and the head brought home." So the custom depicted in the glyphs here is one that the Shoshoneans of California practiced, thus apparently showing that the people who made the glyphs were of the same stock of peoples as the Southern Paiute-Chemehuevi and the other California Shoshoneans. The glyphs they left undoubtedly prove that they were of the Shoshonean family of Indians. The same California Indians kept the captured women and children as slaves (pp. 647 and 752): and the constant object of many war parties was such capture, thus bringing to mind the scenes in the glyphs here of war parties returning with captured women and children.

The purposes of the glyphs has puzzled the various investigators. Though they appear to be in a sense narrative, each glyph probably representing a narrative incident, that is, the glyph would call up some event with its various details, there is not enough uniformity to indicate that each character stands for a definite idea wherever placed, as is the case of the Egyptian hieroglyphs, for example. On the other hand, they do depict scenes and probably do record events in the lives of the principal actors. It would therefore seem at least a part of them are epitaphs setting forth the principal events of the deceased actor's life and that they were drawn as a part of his death ceremony. The other glyphs, for the most part, were apparently explanations of myths and the recording of conspicuous, general events.

It would seem that some of the California Indians had a ceremony somewhat the counterpart of the one first mentioned. The Kitanemuk stuffed clothing to represent the dead and these articles were burned with the property of the dead at the close of the death ceremony (Kroeber, 1925, p. 613). The Diegueno and Kamia have an image ceremony for the dead which lasts six nights (p. 716). The Maidu also used images of the dead in the death ceremony, especially for persons of note (pp. 431-432). The Chumash also erected boards bearing rude pictures (p. 557). It would seem that many of the glyphs here answered some such purpose as the last above, eulogizing the dead.

When one views these glyphs, especially pictographic group P72, he must conclude that the people who made them were on a higher plane of civilization than the peoples that were found here by the white explorers. It would therefore seem that that civilization must have declined as its people were pushed southwestward by stronger and more savage peoples.

That these people were Ute-Chemehuevi and likely of the Southern Paiute-Chemehuevi division of that stock of Indians these seems but little doubt, as we have stated. That they were ancestors of at least a part of that stock is borne out by the fact that the Chemehuevi name for the Hopi at the present time (p. 595) and the Ute name for the people who left the Hill Canyon and Nine Mile Canyon villages, forts, and cliff-houses here are the same, Mukwi or Mokwits.

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THE BIOLOGICAL ANATOMY OF TRIOSTEUM PERFOLIATUM

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The genus Triosteum is a member of the Caprifoliaceae or honeysuckle family as well as such well known plants as the weigelas, the bush and vine honeysuckles, the coral-berry, the viburnums and the elder, and also the slender creeping linnaea or twin-flower, not familiar in this part of America. The species of Triosteum, along with Linnaea, are herbaceous members of the family. Our species, T. perfoliatum, although not uncommon in our woods and growing tall enough to be conspicuous, seems to run its course year after year, unnoticed and unnamed by the people. It is true that Gray records Tinker's weed and wild coffee as its accepted common names, but while these names may have a history and a vogue sometime, somewhere, they appear so inept to the uninitiated that their passing need not be mourned. For the whole genus Gray cites the name feverwort and horse gentian. The first of these names refers to a reputed medicinal quality. One finds in Good's Family Flora, a pharmaceutical text of ancient vintage, several paragraphs of enthusiastic commendation in which occurs the following sentence, "In fevers the plant is one of the most valuable articles in the catalogue of medicines."

Triosteum perfoliatum is a coarse herbaceous perennial with stout stems 0.6 to 1.3 m. high and densely beset with soft glandular hairs. Near the apex, the stem is square but gradually becomes rounded towards the base. A very short distance below the apex, the stem becomes hollow. The vascular system is in the form of a continuous cylinder, broken only at the nodes where the leaf traces slip out sharply leaving a very shallow gap. Five bundles from the stem enter each leaf and since there are two leaves at each node, ten bundles slip out from the cylinder at each node.

Evidently the stem depends mainly upon the xylem to support itself, since there is little collenchyma in the cortex and not enough bast fibers to give much support. The latter are arranged in the form of a broken ring just within the endodermis.

When sections of the stem were tested for cell contents, oil was found generally distributed in all regions except the xylem and trichomes. No resin, mucilage or starch was found in the stem. Calcium oxalate was present in the cortex, phloem, pith, and pith rays. Most of the calcium oxalate was in the cortex just outside the endodermis and the cells of the pith bordering upon the hollow interior. Some tannin was found in connection with the calcium oxalate. When tested with Fehling's solution, sugar was found to be present in the trichomes, epidermis, cortex, pericycle, xylem and in small amount in the pith. When tested with phenylhydrazenehydrochloride, these sugars were found to be fructose, glucose and saccharose.

Towards the end of the growing season the stem gradually dies and buds arise from the large main root at the base of the stump of the main stem.[1] Usually only two buds arise on opposite sides of the stump but other buds may be formed on the main root and other and smaller buds also may arise from the smaller lateral roots. The first and largest buds are those around the stump of the dead stem which have formed before winter sets in and usually grow to be 2 to 3 cm. long and about 6 mm. thick. The buds overwinter just beneath the surface of the soil without other protection. In these buds there is scarcely any differentiation of tissues. The bud scales which are covered with numerous trichomes have no differentiated tissues other than a few simple veins. There are no stomata on either surface of the scales. When sections of the bud were tested for cell contents, no resin, oil or mucilage were found, but a considerable amount of starch was found generally distributed through the sections, except in the phloem. Tannin was present all through the section and was especially abundant in the epidermis and adjoining cortex which was three to four cells thick, and in the cells bordering the xylem and just outside the phloem. Tests showed the sugars, saccharose, glucose and frutcose, were present in bud sections.

The main root is enlarged, folded, twisted and distorted with dead tissues intertwined with the living. Usually a dead portion is to be found in the very center. All of the tissues outside the xylem are quite spongy in the case of both the main root and lateral roots. The xylem in the lateral roots is in the form of a solid rod as there is no pith. No mucilage or resin was found in the cells of the root. Tannin was present in the epidermal cells and in several rows of the cells just inside the epidermis. A large amount of starch was found in the tissues outside the xylem and in the xylem parenchyma and xylem rays.

The leaves are dark green, oval, rather thick, pubescent and 10 to 22 cm. long. The lower leaves are abruptly narrowed below the middle with connate-clasping bases 4 to 7 cm broad. The uppermost leaves are tapering or scarcely connate at the base. The midrib is prominent and well strengthened both above and below by collenchyma. Both large and very small veins branch off from or fuse with the midrib. Some of the ends of the veinlets are free forming an open network while others unite forming a closed network. All of the stomata are situated in the lower epidermis. There are approximately four hundred stomata per mm^2. The palisade chlorenchyma is sometimes one and sometimes two cells in thickness. There are approximately sixteen thousand four hundred palisade cells per mm^2. that is, there are forty palisade cells for each stoma. The cuticle is about 0.001 mm. thick on both upper and lower surfaces.

1. Editor's note: That is, a hemicryptophyte.

No mucilage, resins or tannin were found in the leaves. Starch was present in the border parenchyma. Oil was found abundantly in the palisade parenchyma, spongy parenchyma and guard cells but not in the midrib. A glucoside was found in the trichomes, mostly in the upper side of the leaf and some in the midrib.

There are usually six to eight dull orange-yellow fruits at each node. The three nutlets contained in each fruit are three ribbed, one-seeded and bony. Evidently these nutlets may pass through a long period, possibly several years of dormancy before germinating, since they were not softened by treatment with hydrofluoric acid, sulphuric acid, or long boiling in water nor by a combination of all three treatments. The endocarp is composed of stone cells and lignified fibers closely interwoven. No starch, mucilage or resins were found in the fleshy portion of the fruit but some oil was found in a few cells just beneath the cuticle. Tannin was present in the epidermal and sub-epidermal cells including an area several cells in thickness below the epidermis. Sugar was found in all cells except trichomes. Some crystals of calcium oxalate were found scattered through the cells.

Recounting various products found in different parts of the plant, we note calcium oxalate in the stem, bud and fruit; tannin in the stem, bud, root and fruit; fructose in the stem, bud and fruit; glucose in the stem, bud, root and fruit; a glucoside in the leaf; saccharose in the stem, bud and fruit; oil in the stem, leaf and fruit; starch in the bud, root and leaf. There was no mucilage or resin in the entire plant. An especially noteworthy feature is the abundance of tannin and sugars—these would lower the freezing point of the cell sap and may help the succulent buds to survive the winter.

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THE FLORA OF CLOUD COUNTY

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Aurora, Kansas

Cloud County, from which the plants contained in the subjoined list have been collected, is situated in the North Central part of Kansas and has an area of 720 square miles. Pioneer settlement of the county began as early as 1860 and two decades afterward the entire farmland was under cultivation. The chief crops are wheat, corn, oats and alfalfa. Cattle grazing is pursued to some extent on the uplands. The average annual rainfall is about 26 inches.

The Republican river passes through the northern part of the county and the Solomon river cuts through the southwest corner. The valley of the former is exceptionally sandy throughout the county and this condition accounts for quite a number of species of plants. Between these two rivers there is a hilly divide where several creeks rise and where a number of marshy springs may be found. The eastern and southern part of this divide is characterized by red sandstone hills, while the central and western part has limestone hills. It is interesting to note the flora peculiar to each of these geological conditions, particularly that of the limestone hills upon whose summits are found plants that are rarely seen in any other part of the county, as for instance Megapterium missouriense, Polygala alba, Solidago rigida, Ceanothus ovatus, Penstemon cobaea, Viorna fremontii, mentioning only a few species. The sand hill region is noted for such plants as Geranium carolinianum, Coryphanta missouriensis, Cracca virginica, Solidago rigidiuscula, Penstemon acuminatus, Baptisia bracteata and many others. In the extreme northwest part of the county there are several salt mrshes with their characteristic plants, as Atriplex hastata, Atriplex argentea, Dondia linearis, Scirpus paludosus, and the grass, Distichlis spicata, which literally covers the marsh bottoms. The old Lake Sibley, which formerly existed northwest of Concordia, has been reduced by the changing course of the Republican river, to a few little lakes and marshes. These are of interest to the botanist as quite a number of rare species have been gathered there. A few sand hills are to be found in the southeastern part of the county that are of particular interest, especially the Adam's sand hill southeast of Aurora.

The woodlands of the county are confined chiefly to the borders of the streams, the rivers, the creeks, the springs and along the roadsides. Though these woodlands do not assume the proportions of a forest, they are nevertheless quite extensive in places. They are stately, varied and beautiful, presenting a magnificent aspect when contrasted with the rolling plains or the waving fields of grain. It is deplorable to behold the ruin and devastation done to our limited

timberland by the ruthless onrush of industrial and agricultural pursuits. Large trees felled for private gain are not replaced and are not allowed to be replaced due to the fact that the woodlands are heavily pastured and the cattle destroy the seedlings.

Previous to the year 1898 Professor Hitchcock of the Kansas State Agricultural College of Manhattan, made a botanical survey of Cloud county and listed some 240 plants which number was then considered to be a fairly complete representation of the county's flora. The present list was made in 1930 and contains a little more than 600 plants. Hitchcock's work is incorporated in this list. Those of his list that I have been unable to find, possibly ten or fifteen, are marked (*).

It may be easily concluded from the small number of the undiscovered plants of the former list that agriculture, though it has been responsible for the quantitive destruction of certain plants growing on native soil, has not driven a very large number of species out of the county. Some of the plants missed in this survey were undoubtedly plants introduced by cultivation as for instance Vaccaria vaccaria, which, due to unfavorable soil and climatic conditions, could not survive long. Moreover the year 1930 was one of the driest on record and the author personally observed the failure of one species, Polygala verticillata to show up that year in localities where the previous year it grew in abundance. A very large number of plants contained in this list came to the county with the county's development.

The present collection represents a hundred families with the Composite family leading in number, 98; the grass family next with 87; then the pea and sedge families with 44 and 38 respectively. Specimens of the plants listed have been sent to the Botanical Department of the Kansas State Agricultural College of Manhattan where they have been mounted and placed in the herbarium.

In the classification of the county's plants I followed Britton & Brown's "Illustrated Flora of the United States and Canada". In the task of identifying and classifying many of these plants I am much indebted to Dr. F. C. Gates of the Agricultural College, whose untiring interest in preparing a manual of the State's flora has been the inspiration of this collection.

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Woodsia obtusa, 557
Pellaea atropurpurea, rare, 558

Fam. Marsileaceae

Marsilea vestita, 560

Fam. Equisetaceae

Equisetum hyemale*
Equisetum arvense, 561
Equisetum laevigatum, 562

Fam. Pinaceae

Juniperus virginiana, 559.
A single tree.

Fam. Typhaceae

Typha latifolia, 564

Fam. Sparganiaceae

Sparganium eurycarpum 563

Fam. Potamogetonaceae

Potamogeton heterophyllus
Potamogeton foliosus, 565
Potamogeton diversifolius, 566
Potamogeton dimorphus, 567

Fam. Naiadaceae

Zannichella palustris, 569

Fam. Alismaceae

Alisma subcordatum, 570
Echinodorus cordifolius, 571
Lophotocarpus calycinus, 572
Sagittaria latifolia, 573

Fam. Poaceae

Tripsacum dactyloides, 574
Andropogon scoparius, 575
Andropogon furcatus, 576
Sorghastrum nutans, 577
Holcus halepensis
Holcus sudanensis, escaped. 578
Syntherisma sanguinale, 580
Syntherisma marginatum, 47
Leptoloma cognatum, 43, 581
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Paspalum stramineum, 583
Echinochloa crus-galli, 584
ditto long awned, 585
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Panicum dichotomiflorum, 586
Panicum capillare, 588
Panicum virgatum, 587
Panicum pseudopubescens 680
Panicum hauchucae, 681
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Panicum scribnerianum, 679
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Aristida wrightii, 598
Aristida longiseta, 599
Aristida oligantha, 601, 603
Aristida purpurascens, 602
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Sporobolus neglectus, 611
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Sporobolus asperifolius, 37, 42, 616
Cinna arundinacea 41, 617
Agrostis palustris, 618
Agrostis hyemale, 619
Calamovilfa longifolia, 620
Capriola dactylon, 579
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Spartina michauxiana, 621
Chloris verticillata, 622
Schedonnardus paniculatus, 623
Bouteloua hirsuta, 624
Bouteloua oligostachya, 625
Bouteloua curtipendula, 626

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Bulbilis dactyloides, 628
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Triplasis purpurea, 48, 630
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Eragrostis hypnoides, 637
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Poa pratensis, 642
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Festuca elatior, 646
Festuca nutans, 647
Bromus tectorum, 648
Bromus inermis, 649
Bromus secalinus, 650
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Bromus japonicus, 652
Bromus ciliatus, 653
Bromus arvensis, 651
Lolium multiflorum, 654
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Agropyron smithii, 655
Hordeum pusillum, 656
Hordeum jubatum, 657
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Elymus canadensis, 69, 659

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Cyperus inflexus, 36, 661
Cyperus schweinitzii, 662
Cyperus houghtoni, 663
Cyperus acuminatus, 665
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Scirpus lineatus, 17
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Carex cephalophora, 20
Carex vulpinoidea, 21
Carex stipata, 22
Carex scoparia, 23
Carex festucacea, 24
Carex heliophila Mackenzie, 25
Carex meadii, 26
Carex grisea, 27
Carex bushii, 28
Carex stricta, 29
Carex interior, 33
Carex lanuginosa, 30
Carex atherodes Spreng, 31
Carex hystricina, 32

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Tradescantia bracteata, 57, 58, 59
Tradescantia reflexa
Tradescantia occidentalis, 60

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Fam. Juncaceae

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Juncus tenuis, 68
Juncus interior, 63, 64
Juncus torreyi, 62

Juncus nodatus, 65
Juncus diffusissimus, 66, 67

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Allium nuttallii, 70
Allium reticulatum,not common, 72
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Yucca glauca, 74
Asparagus officinalis, 75
Vagnera stellata, A leafy form. 76
Polygonatum commutatum, 77
Smilax hispida, 78

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Gemmingia chinensis, rare. 79
Sisyrinchium campestre, 80

Fam. Orchidaceae

Ibidium cernuum*
Ibidium gracile, A single plant. 81

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Fam. Salicaceae

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Populus nigra italica, cultivated, 84
Salix longifolia, 86
Salix amygdaloides, 87

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Ulmus fulva, 91
Ulmus racemosa, 90
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Humulus lupulus, 96
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Urtica gracilis, 98
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Fam. Santalaceae

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Rumex altissimus, 104
Rumex patientia, 105
Rumex crispus, 106
Rumex persicarioides, 107
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Persicaria longistyla, 117
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Fam. Caryophyllaceae

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Myosurus minimus, 276
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Ranunculus abortivus, 274
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Radicula palustris, 290
Radicula sessiliflora, 289
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Fam. Crassulaceae

Penthorum sedoides, 305

Fam. Grossulariaceae

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Ribes odoratum, 307
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Fam. Rosaceae

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Vicia sparsifolia, 219
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Oxalis cymosa, 208

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Linum lewisii*
Linum rigidum, 207
Linum sulcatum, 206
Linum compactum, A. Nelson, 205

Fam. Balsaminaceae

Impatiens, sp. 203
A single plant without flowers.

Fam. Zygophyllaceae

Tribulus terrestris, 202
Kallstroemia intermedia, 201
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Fam. Rutaceae

Zanthoxylum americanum, rare. 200

Fam. Simarubaceae

Ailanthus altissima, 199

Fam. Polygalaceae

Polygala verticillata, 198
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Croton glandulosus, Rare, 196
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Tithymalus missouriensis, 128
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Poinsettia heterophylla, 130

Fam. Callitrichaceae

Callitriche heterophylla, 131

Fam. Anacardiaceae

Rhus glabra, 132
Toxicodendron radicans, 133

Fam. Celastraceae

Euonymus atropurpureus, Rare, 134
Celastrus scandens, 135

Fam. Aceraceae

Acer saccharinum, 136
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Acer negundo, 137

Fam. Rhamnaceae

Ceanothus ovatus, 138

Fam. Vitaceae

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Fam. Cactaceae

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Elaeagnus angustifolia, 185
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Ammania coccinea, 156
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Epilobium adenocaulon, 160
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Raimannia rhombipetala, 165
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Meriolix serrulata, 168
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Gaura coccinia, 170
Gaura biennis, 171
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Fam. Halorrhagidaceae

Myriophyllum pinnatum, 173

Fam. Apiaceae

Eryngium leavenworthii, 174
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Sanicula canadensis, 175
Cogswellia daucifolia, 176
Anethum graveolens, 177
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Spermolepis patens, 178
Conium maculatum, 180
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Fam. Cornaceae

Cornus asperifolia, 181

Fam. Primulaceae

Androsace occidentalis, 182
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Fam. Oleaceae

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Fraxinus pennsylvanica lanceolata, 184

Fam. Apocynaceae

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Apocynum sibiricum, 406

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Asclepias tuberosa, Rare. 408
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Verbena bracteosa, 441
Verbena bipinnatifida, 442
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Veronica peregrina, 485
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Fam. Lent'bulariaceae,

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OBSERVATIONS ON THE BREEDING OF THE GUINEA-PIG

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A total of 88 female guinea-pigs observed before and after breeding were killed and dissected. Of the 68 that showed a vaginal plug after copulation, 63 were found to be pregnant and 5 were non-pregnant. Of 20 uncertain cases 6 showed a pregnant condition and 14 were non-pregnant. As a rule the presence of a vaginal plug is evidence of successful copulation, but occasionally a successful copulation may occur without the subsequent vaginal plug. However, as Stockard and Papanicolaou (1919) point out, copulation cannot occur unless the vagina is open.

Our observations are not completely in accord with those of Stockard and Papanicolaou. Many females were observed to allow the male to vigorously attempt copulation when the vagina was completely closed. In some cases apparent copulation (as far as observed activity was concerned) would take place every day or at intervals of three or four days. On the other hand many females with an open vagina would vigorously resist the male's attempts to copulate. Likewise, after parturition the female might or might not permit copulation. At times the male was observed to pursue the female for as long as a half hour with no opportunity for attempted copulation.

As Stockard and Papanicolaou state there is a period of complete relaxation immediately following a successful copulation. This is more marked in the male than in the female.

THE FETAL MEMBRANES OF THE GUINEA-PIG (CAVIA COBAYA)

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The guinea-pig exhibits the "inversion" of germ layers to a very marked degree. J. T. Wilson (1928) in reviewing the literature by Graf Spee, Selenka, and Maclaren on the early stages and implantation of the guinea-pig interpreted the blastocyst as having a complete trophoblastic wall up to the seventh day; the same was found by Hill and Sansom (1930). We have found that by the eighth day the endoderm has formed an elongated closed cylinder in which at one end is the ectodermal amnio-embryonal mass. At the other end the endodermal yolk sac is continuous with the ectoplacental trophoblast. The trophoblast other than that at the placental pole, degenerates. Thus the endoderm of the incomplete yolk sac is brought

directly in contact with the maternal tissue; however, at no point does it form a villous attachment. This is the same relationship that Patterson (1927) describes in the nine banded Armadillo.

The allantois appears early in the 13th day as a spongy mass of mesoderm at the posterior end of the embryonic disc. This becomes greatly enlarged by the 16th day and has a slight endodermal outgrowth pushing into it from the end of the hind-gut. By the 17th and 18th days the allantois has further grown out between the amnion and chorion until it finally reaches the ectoplacental area and forms a part of the placenta.

The chorion is developed only slightly. Really the only part of the chorion which exists is the small part of the placenta that early was the ectoplacental trophoblast.

In the full term embryo the endodermal yolk sac surrounds the fetus except for the small area occupied by the placenta; it may be easily separated from the placenta with little or no hemorrhage. The yolk sac blood supply is through the vitelline artery and vein. The umbilical arteries and umbilical vein go to the placenta.

THE DEVELOPMENT OF THE EXTERNAL FORM OF THE GUINEA-PIG (CAVIA COBAYA) BETWEEN THE AGES OF 11 DAYS AND 20 DAYS OF GESTATION

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(Abstract of the Material to be Used for the Master's Thesis)

From the 63 pregnant female guinea-pigs killed for dissection a total of 210 embryos were secured. The youngest embryos successfully dissected out were 11 days 8 hours copulation age. They were elongated vesicles approximately 3 mm. long, with the trophoblastic implantation pole at one end; at the opposite end is the embryonic disc presenting the "inversion" of the germ layers. The average weight of the blastocyst with the deciduate maternal membranes is 0.154 gm. The weight of the 13 day cyst has increased to 0.339 gm.; the vesicle alone measures 5 mm. by 1.5 to 3 mm. The vesicle is tending to widen and flatten rather than to further elongate. The enlarged embryonic disc with the amnionic cavity dorsal to it, has developed to the primitive streak stage with the mesodermal outgrowth of the future allantois appearing at the posterior end.

The weight of the decidua and blastocyst at 14 days is 0.477 gm. The embryonic disc, 1.5 to 3 mm. in length, has developed from the early primitive streak stage to the 5 somite stage with prominent unfused medullary folds, which in the anterior part are wide flat

thickened plates. As these folds develop further they begin to fuse together in the region of the first mesoblastic somites, while the extreme anterior part is merely starting to fold up. There is an indication of the vitelline veins.

At 15 days the blastocyst and decidua weigh 0.617 gm. The embryos averaging 3.7 mm. in length show approximately the same degree of development as does a 24-hour to 36-hour chick embryo.

In the late 15 day embryos the primary vesicles of the partially closed neural tube are differentiating; the number of somites has increased to as high as 15; the elongated heart tube is twisting slightly; the optic vesicles are noticeable; the ventral body wall has closed anterior to the heart; the mesodermal part of the allantois appears as large as the embryo itself.

Embryos of 18 days, averaging 4.4 mm. in length and 0.05 gm. in weight, have 18 to 20 somites. The neural tube, closed anteriorly, has differentiated into the primary vesicles. The ventral body wall has closed resulting in the slight formation of the flexures; the heart tube has made a complete twist upon itself; 4 branchial arches are present; the optic cup and lens are forming; the otocyst is open to the exterior.

At 17 days the embryos average 0.056 gms. in weight and 5.49 mm. in length. At 18 days the weight is 0.066 gm. and the length is 6.47 mm. The somites have increased to 30 to 37; all body flexures are well formed; the secondary vesicles of the brain are differentiating. There are no outstanding changes but a general further development of all structures.

At 19 days the average length of the embryos is 8.26 mm. and the average weight is 0.117 gm.; there are 41 somites, the final number; the pontine flexure is forming in the brain, the parts of which are now well differentiated; 2 branchial arches are still present; pigmentation of the iris is beginning; the endolymphatic duct is present; the atrial and ventricular portions of the heart are distinguishable; the somites are differentiating into myotome and sclerotome.

The 20 day embryos, on the average, measure 9.12 mm. in length and weigh 0.139 gm. All structures found in the 19 day embryos have undergone a slightly further development.

THE ACADEMIC, VOCATIONAL AND MATERNAL STATUS OF THREE HUNDRED FIFTY MARRIED WOMEN GRADUATES OF THE UNIVERSITY OF KANSAS

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In June 1929 a questionaire was sent to the listed, married women graduates of the University of Kansas. The purpose of this questionaire was to obtain information as to the homemaking and maternal experiences of these women with particular reference to the relation between these experiences and their previous educational and vocational experiences.

Three hundred and fifty answers were received which furnish the basis of a report, a fragment of which is presented here.

It is frankly admitted that the 350 women answering may not constitute a fair "sample" of the 1800 women in the entire group of women graduates who had reported their marriages to the Alumni office. It has been impossible to make an analysis of the total group or check these tabulations against any control.

The purpose of the inquiry was to get such information as might be afforded by the actual experience of a group of intelligent college women as to the needs and difficulties of the American home today and as to how the University has helped its students to meet their domestic problems and, especially, to get suggestions as to how the University may better serve the American home.

Certain incidental information contained in these questionaires may have some interest for this group and is here presented, not as research, but rather as a picture of the maternal and academic accomplishments of 350 University women whose postgraduate life covers the considerable span of more than half a century since the oldest date of graduation was 1875 and the youngest 1928.

As a matter of interest, the answers were classified in three groups according to the date of graduation of the writers, first, graduates within ten years, i. e. 1919 to 1928 inclusive, of whom there were 152 or 52% of those answering the questionaire: second, graduates of ten to twenty years ago, or 1918 to 1909 inclusive, of whom there were 99, or 28%: and third, graduates of more than twenty years ago, or 1908 to 1875, of whom there were 69 or 20% of the total. Both of these groups was further divided into those having children and those having no children.

Age and Sex of Children

No one of the first ten-year group has more than four children, and only three, who were married previous to university residence, have this many; five have three children each and eight have two;

fifty-nine or 32% have one child each and seventy-seven or 42% have none. While this averages only 1.54 child per mother and .89 child per individual in the entire group, it must be remembered that no woman can reasonably be expected to produce more than three or four children within ten years even though she married before or immediately after graduation. Many of this group have married only recently hence it is reasonably certain that numbers of those will continue to have children.

The second ten-year group made a somewhat better apparent showing in that only sixteen, or 16% of those reporting, still have no children; sixteen or 16% still have but one child; thirty-six or 36% have two children each; twenty-six or 26% have three; two or 2% have four and three or 3% have five each or a total of 2.26 children per mother and 1.89 children per individual among the group of graduates of ten to twenty years ago.

The graduates of longer ago than twenty years show thirteen or 19% who have never had children as against 16% of the middle group; fifteen or 22% who have one each, as against 16% of the middle group; seventeen or 25% who have two children; ten or 14% who have three children; six or 9% who have four, while eight have five to eight children each. This gives an average of 2.7 children per mother and 2.2 for the entire group, who are, presumably, near the close of this chapter of their lives.

Assuming that these figures for the older group are relatively fixed, and remembering that twenty years and more ago women were stil convention bound and voluntary parenthood an obscure idea both as to sanction and practice, it is of interest to note that the 56 graduates of this group who returned the questionaire and who had children produced only 2.7 children apiece. Thus far other groups have produced only 2.3 per mother between the years 1909-1915 and 1.5 per mother since 1919. In the nature of things these groups may yet do as well in this respect as their University graduate mothers and grandmothers.

The sex of the reported children is distributed in the ratio of 51.6% male to 48.4% female. The greatest divergence is with the children of the younger mothers where the showing is 88 males and 74 females. The other two groups show almost a fifty-fifty ratio.

The ages of the children range from a few months to 48 years. Only four children over ten years of age are reported by the youngest group. The oldest group reports no child under four years and only ten children who are under ten years of age. The middle group reports 121 or 64% of children under ten years and only one child over eighteen.

Major Subjects

Considering first the subjects which were available for choice during the entire period, we note that English leads in frequency as major subject for the two recent graduate groups while Modern Language, notably German, heads the list with the oldest group, although German seems to have been equally popular with the group graduating from 10 to 20 years ago, since approximately 15% of each group majored in German. As might be expected from the effect of the War taboo, French and Spanish have largely replaced German within the past ten years. This is in keeping with the general trend of college interest in these languages.

Next in sequence after English and Modern Languages comes Home Economics. Since it was not offered as a subject prior to 1910, with the first majors declared in 1913, it does not appear among the answers of the older group and only 4% of the graduates between 1909 and 1918 elected this as their major subject. It is interesting to note that 12% of the 182 women graduating since 1918 elected this major.

History comes fourth in order of frequency and that because of the curiously accelerated interest of the middle group, 12% of whom elected History as a major as against 4.4% in each the earliest and latest groups.

Latin and Music tie for the next place with 20 majors each. Latin shares the apparently declining interest in all languages in that 13% of the oldest group majored in Latin and only 1.1% of the youngest group. Music has maintained a small but fairly even popularity.

Journalism is increasing in popularity as mathematics decreases. Sociology, Bacteriology, Entomology, Economics and Psychology appear only upon the selections of the recent group.

The individual professions do not score very heavily, there being only four majors in Medicine, two in Law, two in Pharmacy and two in Engineering.

Post-Graduate or Other Schooling or Special Training

Out of the 350 married women answering the questionaire, 57.5% have had further educational experience after receiving the A. B. degree from the University.

Nearly 10% of the younger group have degrees of Master of Science or Arts from the University of Kansas or other colleges, while 7.5% of the oldest group have such degrees. The middle group shows 19% having Master's degrees. This group also makes the best total showing, 75.6% having done some kind of post-graduate work.

It is altogether probable that the graduates of the youngest group will add considerably to their showing within the next ten years, although only 47.3% have already done post-graduate work.

Only two women among the 350 included in this investigation have taken the degree of Doctor of Philosophy.

Vocational Activity Between Graduation and Marriage

It is commonly assumed that college women of this generation are delaying marriage for the sake of careers and new vocational interests. The findings of this investigation show, on the contrary, that 86% of the women graduating 20 to 50 years ago pursued some vocation between graduation and marriage as contracted with 84% of married graduates of 10 to 20 years ago, while only 78% of married graduates of the past ten years worked before marriage.

The outstanding vocation is teaching, 63% of the total number and 77% of the group working before marriage having taught. There is a distinct decrease in the numbers of the recent group who followed teaching, only 55% of the total and 70.5% of the group working having taught as contrasted with 84.3% of the middle working group and 84.8% of the oldest working group.

The next vocational activity in order of frequency drops to 3.7% of the total number working and 3.1% of the total group; these served in secretarial capacities.

Next in order is newspaper work and writing, which claims one in each of the older groups and eight in the youngest group. Music comes fourth with nine, or 3.1% of the total vocational group.

These four vocations account for 71.4% of the total number and 87.7% of the total vocational group, leaving 12.3% of the activities of the working group scattered among 16 vocations.

Vocational Activity Aftetr Marriage

That the type in college women has not changed materially is shown by the vocational activities of these women after marriage. At least these particular samples do not indicate that the University woman of twenty to fifty years ago was noticeably more domestic or more confined within home walls than her successor of today. In the absence of time data it is impossible to know how many of these older women may have returned to their vocations after their 2.7 children were old enough not to require their care. However, college women seem to have been definitely coming out of the kitchen, or managing both kitchen and career, for longer than popular, present day discussion would seem to indicate.

We find that 55% or 193 of the women answering questionaires pursued some vocation after marriage. The most radical group in this respect was the middle group who graduated 10 to 20 years ago, 59%of whom pursued some vocation after marriage; 55% of the older group reported post-marriage vocations; while only 53% of the younger group reported such activities.

Again teaching claims the major place, 32.3% of the total number and 58.5% of the vocational group having taught after marriage. Secretarial work, music and journalism again take the next three places. Obviously the women who pursued these vocations before marriage kept on with them after marriage as the figures are practically the same for before and after marriage. The remaining 14.5% evidently followed closely their pre-marriage activities since the variety and sequence closely follows the lines of the previous table of pre-marriage activities.

The conclusion suggested by these fragmentary showings, and the other findings not here mentioned, is that while conditions and curricula have changed, there has possibly not been much change fundamentally in women of the type who elect higher educational careers. They have been radical all along the way, individualistic in the matters of careers and children, but as appears from the voluminous discussions contained in the rest of the questionaire, with wide perspective and interest in education and social organization. Moreover 92% of these women state at the end of the questionaire that their husbands' views coincide with theirs!

GOAL ACTIVITY IN THE WHITE RAT

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The original purpose of this experiment was to make a qualitative study of the behavior of white rats as they learn to make complex choices. Although it became obvious within 200 trials that the problem was too difficult for the rats, the experiment was continued in order to learn what solution the rats would make.

The apparatus consisted of a choice box having three identical paths from the starting place to the food goal. The relative arrangement of three lights of different intensities indicated which of the three paths was open at the goal end.

At the end of 500 trials the rats were still unable to choose the correct paths by means of the lights. They did, however, continually shorten the path from the start to the goal by several means. The first attempted method was to follow the path which had last been correct. Since the same path was never used twice consecutively, this method was unsuccessful and was soon abandoned. All of the rats at one time or another tried to reach the food by ignoring the paths and running along the wall of the apparatus. After 60 trials, four of the rats began to use sequences of paths. This was a sure way to reach the food with no more than 2 errors. The rats finally reduced their errors further by avoiding the path which had been correct on the previous run.

The experiment substantiates the following conclusions:

1. In this experiment, the white rat was unable to choose the correct one of three paths to a food goal as indicated by brightness combinations of three vertical lights.

2. A response may be divided into three parts, the start, the movement and the end or goal. There can be no movement independent of the other two. The goal must be perceived before the activity takes place since without it there could be no movement toward the goal. The response will always take place over the shortest route in time when energy is multiplied by time.

3. Trial and Error as an explanatory or descriptive concept is unscientific because it is based on a double standard and is untrue dynamically. It is also inadequate to explain the directional character of a response.

4. Insight is not static. It expands and differentiates as the animal becomes increasingly aware of the relations of the parts to the total situation.

THE EFFECTS OF SYNTHETIC ATMOSPHERES UPON ANIMAL LIFE

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In previous papers[1] of the Academy it was shown that animals can not live in an atmosphere of pure oxygen under control, nor in an atmosphere which contained 21 per cent of oxygen and 79 per cent of nitrogen by volume leaving out the rare gases.

For different gases alone it was found in a series of experiments that animal life would cease after two to five days in pure oxygen; in pure hydrogen 36 minutes; in nitrogen 6 minutes; in argon 3 minutes; in neon 1 minute and 40 seconds; in helium 2 minutes and 40 seconds; in carbon dioxide 55 seconds; and in nitrous oxide 10 min-

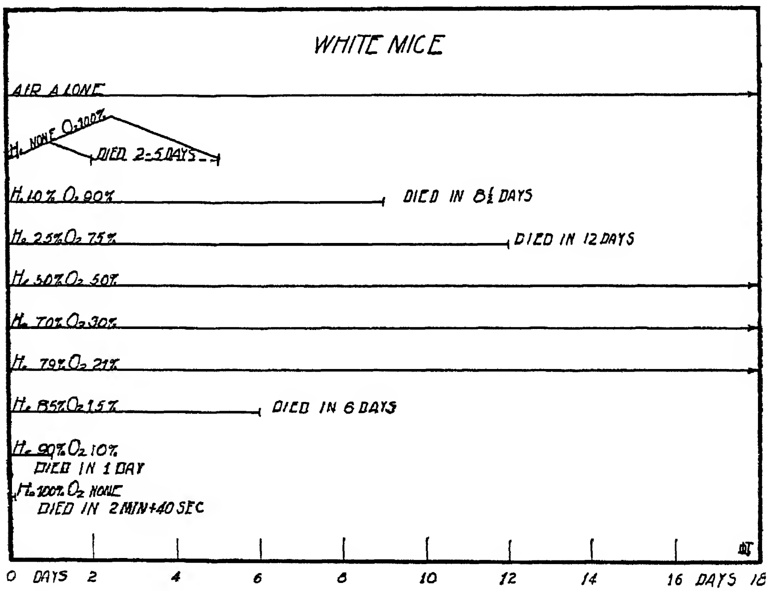

Fig. 1. Diagram showing the relationship between varying combinations of helium and oxygen in a synthetic atmosphere and the life of white mice. The end of the arrows show the number of days that experiments were run.

1. Hershey, J. Willard. A study of the components of air in relation to animal life. Trans. Kansas Academy of Science, 31: 101-102, 1928.
Hershey, J. Willard. Physiological Effects of Oxygen Atmospheres Diluted by Nitrogen. ibid, 32: 51-52, 1929.
Hershey, J. Willard. Animal Life in Synthetic Mixtures of Nitrogen and Oxygen. ibid., 33: 133-135, 1930.

utes. The purpose of these experiments was to find some relation with Graham's gas law of diffusion, but it does not seem to work that way since they live in hydrogen 36 minutes and in helium but 2 minutes and 40 seconds while in nitrogen 6 minutes.

Synthetic Atmospheres of Helium and Oxygen

By using 79 per cent helium instead of nitrogen and 21 per cent oxygen, forms an atmosphere under which animal life (white mice) will exist normally, or in some cases, apparently better than in a normal atmosphere.

In an atmosphere of pure helium alone the animals would live but 2 minutes and 40 seconds. By using an atmosphere of 90 per cent helium and 10 per cent oxygen they would die in one day, and they lived 6 days in an atmosphere of 85 per cent helium and 15 per cent oxygen. The experiments were continued by using mixtures as follows: helium 79 per cent, oxygen 21 per cent; helium 70 per cent, oxygen 30 per cent; helium 50 per cent, oxygen 50 per cent. The animals were under control for three weeks and appeared to be normal and in a few cases better than those in the normal air. In an atmosphere of 25 per cent helium and 75 per cent oxygen they would

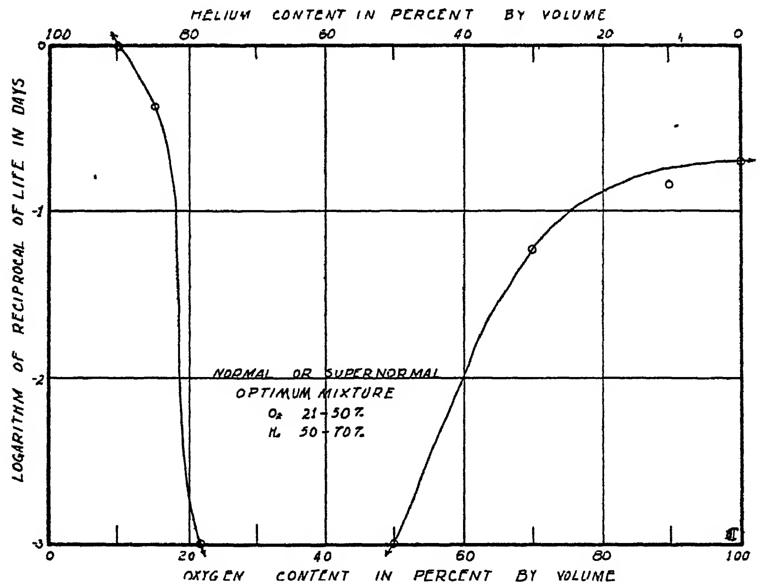

Fig. 2. Graph of the logarithm of reciprocal of life in days of white mice as a function of helium and oxygen in a synthetic atmosphere.

die in 9 days, and they would live but 8.5 days in an atmosphere of 10 per cent helium and 90 per cent oxygen.

In a synthetic atmosphere of 50 per cent helium, 50 per cent carbon dioxide the animals lived 2 minutes and 30 seconds. By using the same percentage mixtures of helium and hydrogen they lived 10 minutes and 10 seconds; with helium and nitrogen 7 minutes; with hydrogen and nitrogen 20 minutes and 40 seconds. The purpose of these last experiments was to endeavor to find some substitute for oxygen. So far as the experiments show it seems that oxygen is necessary as one of the constituent gases but if oxygen alone is used, it will burn out the lungs.

The Maximum Time an Animal Can Cease Breathing and Yet Live

A mouse was tested out with a vacuum pump by placing it under a large bell jar and reducing the pressure to 10 cm. At this pressure the mouse ceased breathing and immediately it was placed in fresh air again, and it began to breathe within a few minutes but it did not become normal for two days. This was repeated by keeping it at this low pressure for 60 seconds, 30 seconds and 15 seconds respectively before placing it in the normal fresh air and under these conditions the mouse would die. These experiments show that the maximum time an animal can cease breathing and yet recover is very short.

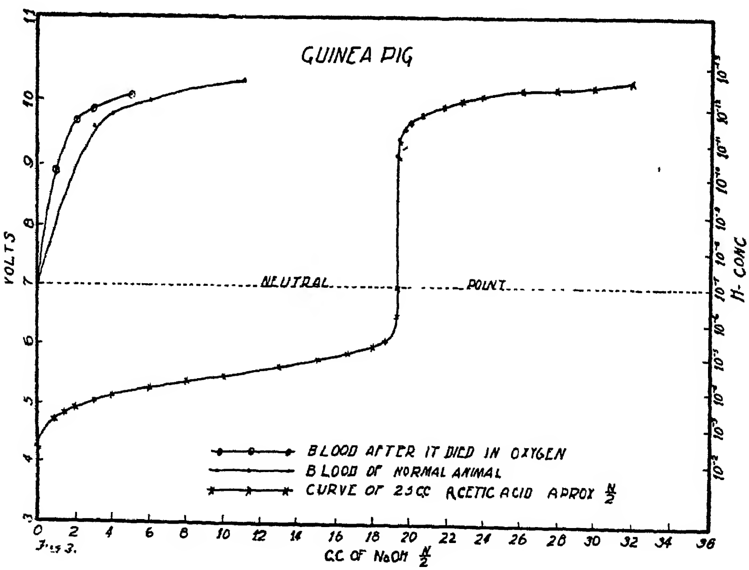

Fig. 3. Graph of the pH of the blood of normal guinea pigs and of guinea pigs which had died in oxygen.

The Effects of Pure Oxygen with 21 per cent Pressure of a Normal Atmosphere upon Animal Life

A mouse was placed in a jar of pure oxygen. By the time the pressure was reduced to about one-third that of the normal atmosphere the mouse stopped breathing. It was immediately restored to fresh air. In this case it did not recover as it did when air was used instead of oxygen. This shows that an animal cannot live in pure oxygen with the reduced pressure as it could have in the air of the same pressure.

Why Animals Die in Pure Oxygen

An examination was made to see why animals die in pure oxygen. It was found that the lung tissue from guinea-pigs which had died in an atmosphere of pure oxygen showed marked evidence of inflammation and interstititial hemorrhage. Cultures made from the lung tissue showed a heavy infection of Bacillus coli associated with a few Staphylococci. The hydrogen-ion concentration of the blood was taken both before the experiment and after the animal died in an atmosphere of pure oxygen. The hydrogen-ion concentration in both cases was about neutral.

ELECTROSTATIC INDUCTOR ALTERNATOR

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Abstract

The electrostatic inductor alternator is a special form of variable condenser that is able to yield a sinusoidal alternating current when excited by a D. C. electromotive force or by a static charge. It may be designed so that the magnitude of its output can be determined from the magnitude of its input and from the constants of its design. Equations for this design and calculation are given. Numerous circuits for the use of the alternator are possible. In one type of circuit the alternator is used as an electrometer, and operates by a null point balance between the effects of a known and unknown static charge or D. C. electromotive force.

Electrostatic Inductor Alternator

The idea of making an electrostatic inductor alternator first occurred to me July, 1927. During the spring of 1928, Mr. T. H. Stevens, who was then our shop technician, constructed most of the apparatus for me, and gave valuable assistance in perfecting its details, as did also my colleague, Professor E. V. Floyd. The construction was completed during the summer of 1928 by Mr. V. V. Cool for whom I was major instructor in the direction of his research, the latter consisting of certain tests and calibrations made upon this instrument.

Briefly, the present model of the electrostatic inductor alternator consists of a toothed aluminum wheel revolving between two stationary Wimshurst plates. Numerous circuits for its use have been tested. Its operation depends upon the periodic variation of capacity between the rotating toothed wheel and the electrodes upon the Wimshurst plates,—the stators. If one set of stators be connected to an unknown E. m. f. with respect to ground, the other set be connected oppositely to an adjustable known E. m. f. with respect to ground, and the rotor be connected through phones (or through amplifier and phones) to ground, the unknown may be measured by the known when adjustment of the latter has caused the musical note in the phones to vanish. This works as well for a static charge, such as an antenna potential, as for a battery potential. The present model measures down to 0.05 volt, at which point frictional electricity developed by the rotation of the toothed wheel in air begins to introduce too much uncertainty. I have plans for making a small electrostatic inductor alternator sealed in a vacuum, and operating the input of one of the new General Electric "FP-54 pliotron" tubes, hoping thereby to develop a quick-acting and rugged competitor for

the quadrant electrometer. It is true, of course, that the new General Electric tube when connected as a direct current amplifier is already the match for most quadrant electrometers. I believe that it may be possible to improve its range by the combination that I have indicated.

The design, size, shape of teeth and circuits for an electrostatic inductor alternator present too many possibilities of variation to be covered in detail in this paper. Only some of the major considerations of design will be given. One possible use of the alternator is for the production of ultra-small but calculable values of sinusoidal E. m. f. We shall give the latter consideration for the remainder of this paper. The method involves the use of a wheel with petal-shaped teeth, and for which other applications exist. One such application is to the design of a photoelectric flicker photometer. The latter is being investigated by Mr. Malcolm Alsop under my direction. The general nature of the construction which we are to consider is a method for sinusoidal modification of effects that can be made to depend upon the area of coincidence between two geometrical figures in parallel planes when one is projected upon the other.

Let us imagine two parallel, insulated metal plates that are very close together and that are the two metal plates of an electrical condenser, a sinusoidal variation of the capacity of which is desired. One of the plates is to be a stator, and the other a rotor. The teeth of the stator have radial edges and project inward from a circle of radius R_1 to a circle of radius r. The stator is shaped like a stamping for the field of an induction motor. There are p equal teeth and p equal spaces between them. The angular width of each tooth is π/p radians.

The petal shaped teeth of the rotor are carried by a central disc that has the radius r, and they project outward from the circle of radius r to the circle of radius R_1. The radial distance y from the circle of radius r to any point at angular position θ on the petal-shaped curve may be determined by the following equation which we shall not take time to derive. h is to be an arbitrary positive constant; and if y+r is to be the radius-vector R, it is obvious that the equation will define the boundary curve of the rotor in polar coordinates. The equation is:

$y=\sqrt{r^2+2hr\ \sin\ p\theta}-r$, permitting only positive values of y for the definition of each petal, and

$y=0$ in the spaces between petals ---------------------------- (1)

The value of R_1 is, $R_1=\sqrt{r^2+2hr}$ ---------------------------- (2)

We shall now find the expression for the area S of coincidence between the stator and rotor teeth,—the active area of the condenser. Referring to Fig. 1:

$dS/p = \frac{1}{2}(r+y)^2 d\theta - \frac{1}{2} r^2 d\theta$, and by Eq. (1),

$dS = phr \sin p\theta \, d\theta$ .... (3)

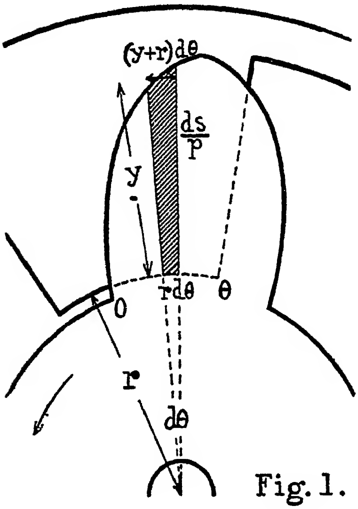

Fig. 1.

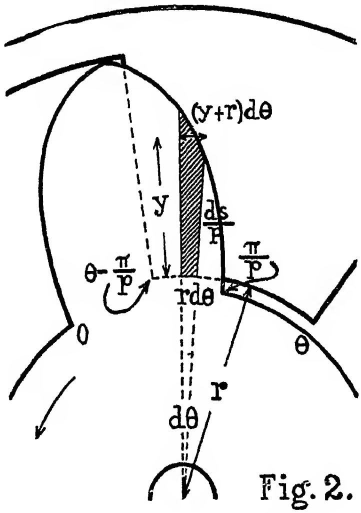

Fig. 2.

When $0 < \theta < \frac{\pi}{p}$

$$S = phr \int_0^{\theta} \sin p\theta' d\theta'$$

$$S = hr(1 - \cos p\theta)$$

Eq.(4).

When $\frac{\pi}{p} < \theta < \frac{2\pi}{p}$

$$S = phr \int_{\theta - \frac{\pi}{p}}^{\frac{\pi}{p}} \sin p\theta' d\theta'$$

$$S = hr(1 - \cos p\theta)$$

Eq.(5).

Let $p\theta - \pi/2 = p\phi = \omega t$ .... (6)

By Eqs. (4), (5) and (6):

$S = hr(1 + \sin p\phi) = hr(1 + \sin \omega t)$ .... (7)

Because of the variable surface S of coincidence between the teeth, the electrostatic inductor alternator is a variable condenser. Also it has a certain amount of fixed capacity that is in parallel with its variable capacity. Therefore, its capacity C may be expressed as a function of time by the following equation:

$C = A + B \sin \omega t$, ... A and B being constants .... (8)

Let us connect directly across C a battery of E volts and negligible resistance. We shall thus obtain a sinusoidal current:

$i = dq/dt = E\ dC/dt = \omega EB \cos \omega t$ ---------------------------- (9)

Next, we shall operate upon the same shaft two exactly equal electrostatic inductor alternators with their phase relation such that, if (8) is the equation for the capacity of the first alternator, the equation for the capacity of the second alternator is:

$D = A - B \sin \omega t$ -- (10)

We shall connect the battery E across C and D in series, and obtain across D an electromotive force e' that is determined as follows. If G is the joint capacity of the two electrostatic alternators in series:

$1/G = 1/C + 1/D, \ldots\ldots G = CD/(C+D),$

$G = (1/2A)(A^2 - B^2 \sin^2 \omega t)$ ---------------------------------- (11)

$q = EG = (E/2A)(A^2 - B^2 \sin^2 \omega t)$ ------------------------------ (12)

$e' = q/D = CE/(C+D) = CE/2A,$

$e' = E/2 + E(B/2A)\ \sin \omega t$ ------------------------------------ (13)

The sinusoidal part of e' is

$e = E(B/2A)\ \sin \omega t$, where A is greater than or equal to B -- (14)

It is necessary that whatever is connected across D,—for example, the grid and filament of a vacuum tube,—to detect e should draw no current. However, it may be of interest to write the current i that flows in the series circuit of C, D and E.

$i = dq/dt = E\ dG/dt,$

$i = -\omega(EB^2/A)\ \sin \omega t \cos \omega t = -\omega EB\ (B/2A)\ \sin 2\omega t,$

$i = -\omega EB\ (B/2A)\ \sin \omega t,\ \omega' = 2\omega,\ f' = 2f$ ------------------------ (15)

It is obvious that the combination above described can be used for the calibration of indicators of small sinusoidal currents and electromotive forces.

Combinations involving inductance and resistance offer further interesting possibilities of a more complicated nature, but will not be presented in this paper.

Other types of design of the teeth of the electrostatic inductor alternator are possible for special purposes, and other circuits and other applications are possible, but are beyond the scope of this paper.

SPECTRAL RESPONSE OF MOLYBDENITE IN VACUO UNDER INFLUENCE OF HEAT

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The actino sensitivity of mineral substances has been studied by a number of investigators among them Hankel[1] is the pioneer. Actino sensitivity or actino-electricity is the emf generated in a crystal when exposed to light, as indicated by a sensitive galvanometer. Scientific curiosity in the matter was first aroused by the discovery of the photo-resistent effect in selenium. Probably the most prominent worker in the field of actino-electricity is Coblentz[2] whose investigations in this field of photo-electricity have been quite fruitful. As late as last year, however, Johnson[3] studied this same effect on molybdenite at higher temperatures, but in no instance was the spectral effect studied under the influence of heat and in vacuo. Hence the present investigation was undertaken.

Construction of Cells

The cells consisted of the stem from the inside of an electric lamp bulb with the sample of molybdenite clamped in the lead wires of the bulb. This assembly was fused into a test tube and a window of cortex glass sealed over the mouth of the test tube. When ready for evacuation, a small glass tube was fused on to the regular exhaustion tube of the bulb, which in turn was sealed off after evacuation. The cell was then ready for the electric oven. The cortex window is a special heat resisting glass with a constant transmission factor at and above 3100 A°, while at 2800 A° as much as 30% of the energy is transmitted.

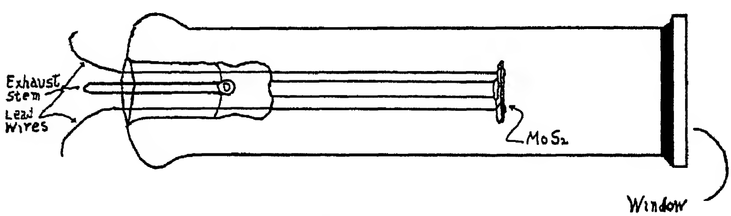

Fig. 1. Cell Construction

The first lot of cells were heated to 300°C, but it was found that this temperature caused wide variations in subsequent readings, while a maximum of 100° to 120° did not permanently impair the sensitivity. A new group of cells was constructed after this first experiment because of this discovery. The cells reported on in this paper were selected from the latter group. Fig. 1 is a sketch of the cell described above.

Apparatus and Method of Observing

The electric oven consisted of a small tin box, which was wound with nichrome wire insulated from the tin box with asbestos cement. This assembly was placed inside a larger tin box and the vacant space filled with dry asbestos cement. The leads were brought out through holes insulated with small glass tubes. A thermometer was inserted through a hole in the top. A type P Leeds & Northrup galvanometer having a sensitivity of 0.0002 microampere was used to measure the current produced by the cell. The galvanometer was read by means of a lamp and scale. The light was furnished by a Cooper-Hewitt quartz mercury arc. Fig. 2 shows a sketch of connections and disposition of lighting arrangement.

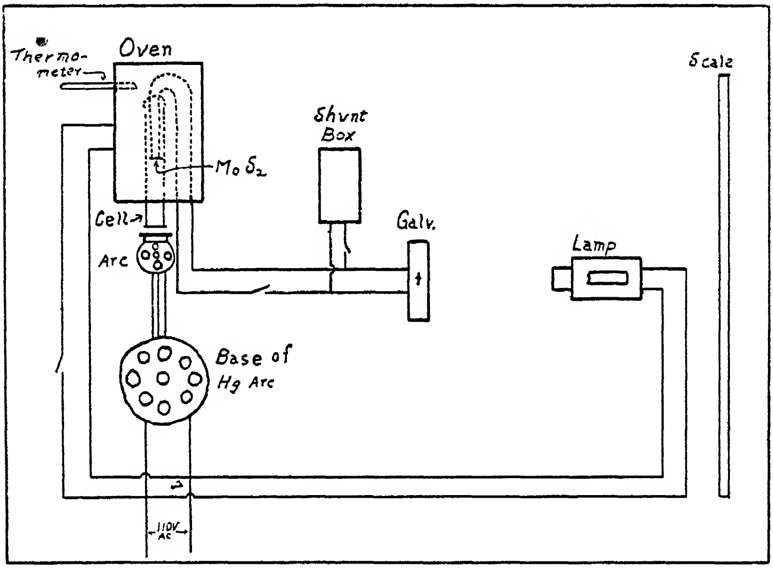

Fig. 2. Apparatus.

Two filters were used to determine the kind of light projected on the cell. One of these filters was yellow in color, and transmitted the 5461 A° green line in addition to all the longer wave lengths in the mercury spectrum. The intensity of the red line was consistently reduced by the filter. The other filter was blue in color and transmitted the 5461 A° green line and the yellow lines, the latter faintly. The blue and violet lines were also transmitted without much absorption. Both filters together transmitted the 5461 A° green line undiminished, and in addition the two yellow lines close by. The intensity of these two lines was much reduced by the filters.

Observations were taken by adjusting the galvanometer to zero while the cell was at room temperaure, and then projecting light on the cell, noting the deflection produced. A reading was taken first for green light with both filters in place, then with the yellow filter in place, then the blue, followed by the unfiltered arc. The heat was then turned on and the temperature of the oven allowed to rise to slightly above 100°C. The current was then shut off, and when the temperature had fallen to 100° a reading was taken for the effect of the heat alone. Green light was then projected on the cell, and the deflection noted. The heat deflection was substracted from this reading. This process was repeated with the yellow, blue, and unfiltered arc. The oven was then allowed to cool to 90° whereupon the entire process was repeated. Readings were taken every ten degrees down to 50°.

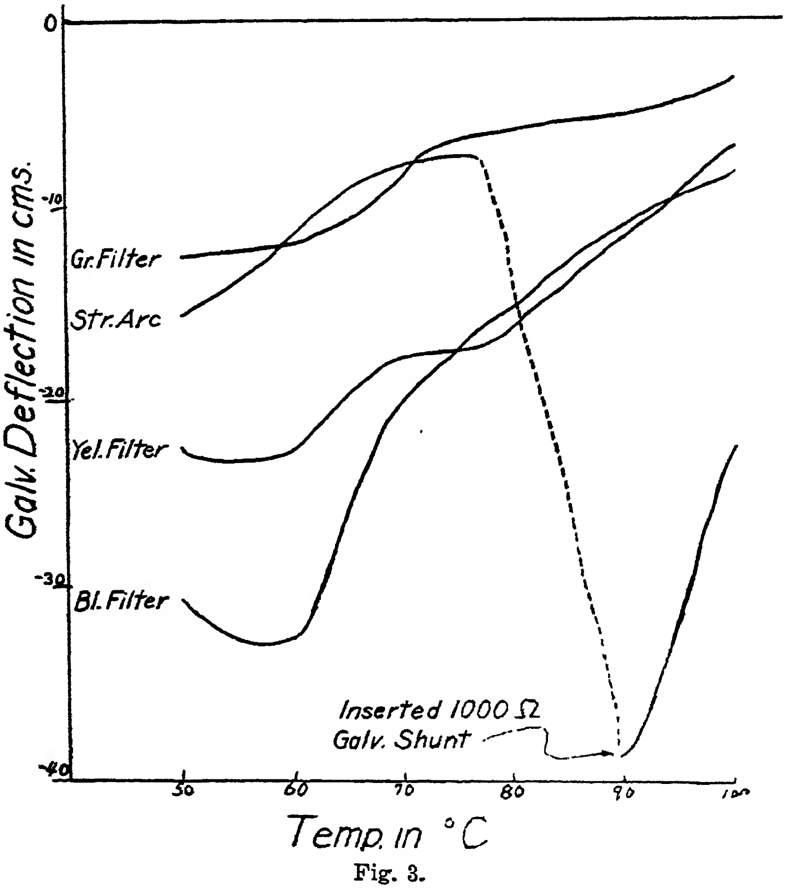

Fig. 3.

Behavior of Cells

Fig. 3 shows the behavior of cell No. 6 when unevacuated. This cell was very sensitive to white light when constructed. The unfiltered arc caused the galvanometer to quickly move off scale when the cell was at room temperature. It was necessary to place a shunt of 7000 ohms around the galvanometer to keep the deflection on scale. However, the deflection rapidly decreased as the temperature was raised. The deflection was a maximum for blue and yellow of 60°. For white and green the maximum was at room temperature or below. Judging from the graph as far as taken, the cell would have lost all sensitivity at about 150°.

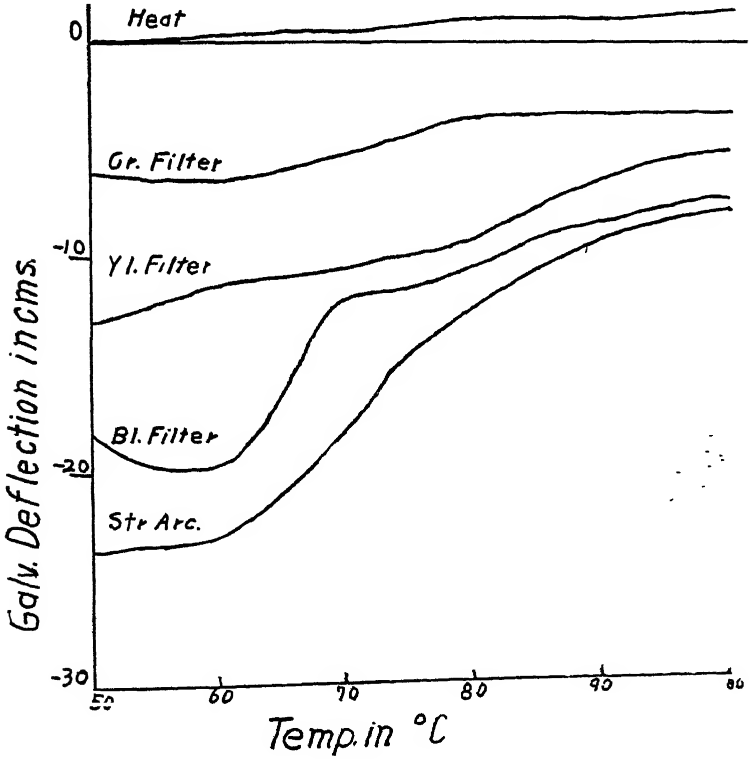

Fig. 4.

Fig. 4 represents the behaviour of cell No. 6 after evacuation. Here green and blue light produced a distinct maximum of 60°. The heat deflection was somewhat enhanced by evacuation. The application of heat caused a general downward shift in the maximum deflection, while a further application of heat caused the response of all colors to diminish and converge toward zero.

Before evacuation, cell No. 7 was only slightly sensitive at room temperature and it completely lost its sensitivity at about 50°. Hence no curve was taken before the cell was evacuated. After evacuation, the cell was fairly sensitive. Fig. 5 shows the response of this cell after evacuation. Green and yellow took the same path. The cell was most sensitive to white light. The deflection for white light reversed at 90°. At 80° the deflection for all forms of light was the same, representing equal sensitivity to all colors. With the exception of green, this same phenomenon was noticed in cell No. 8 when unevacuated.

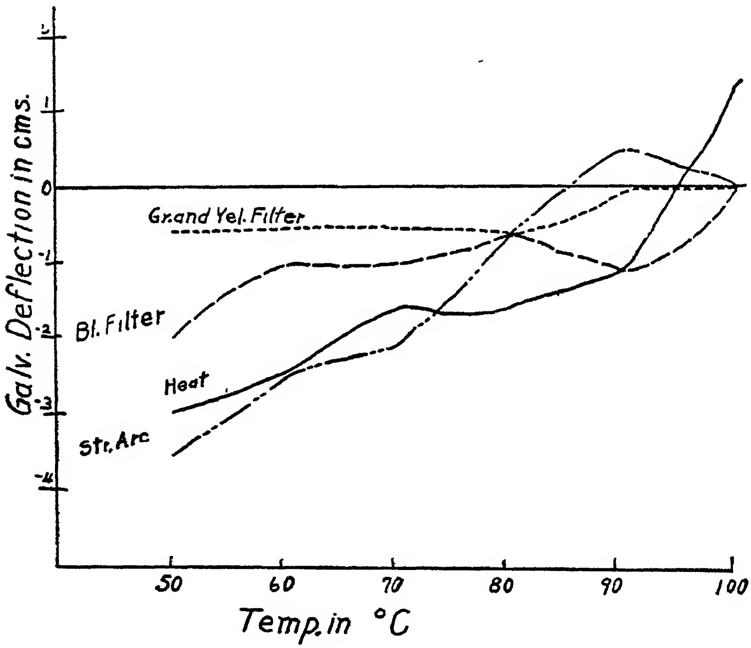

Fig. 5.

Cell No. 8 has a very high resistance and it was almost impossible to shunt the galvanometer properly to steady the deflections, hence the graph taken before evacuation looks rather erratic. After evacuation it was found possible to shunt the galvanometer with 10,000 ohms, making the deflections steady. This cell quite frequently increased in sensitivity as the temperature was raised. The temperature was only raised to 100°, however, for comparison with other cells. The sensitivity for white light increased most rapidly around 70°. Green and yellow had a poorly defined maximum near 80°. Fig. 6 shows the response of cell No. 8, evacuated.

Cell No. 9 was of low resistance and fairly sensitive at room temperature. The sensitivity rapidly decreased around 90° when unevacuated and also when evacuated. The curves for all colors except white light are straight or nearly straight lines. White light produced a much stronger deflection at room temperature than at 100°. The general character of the graph was changed when the cell was evacuated;; the graph for blue, yellow, and green are no longer straight lines. The sensitivity of the cell is somewhat increased at higher temperatures when evacuated as compared with its unevacuated sensitivity. Fig. 7 shows the response of cell No. 9, evacuated.

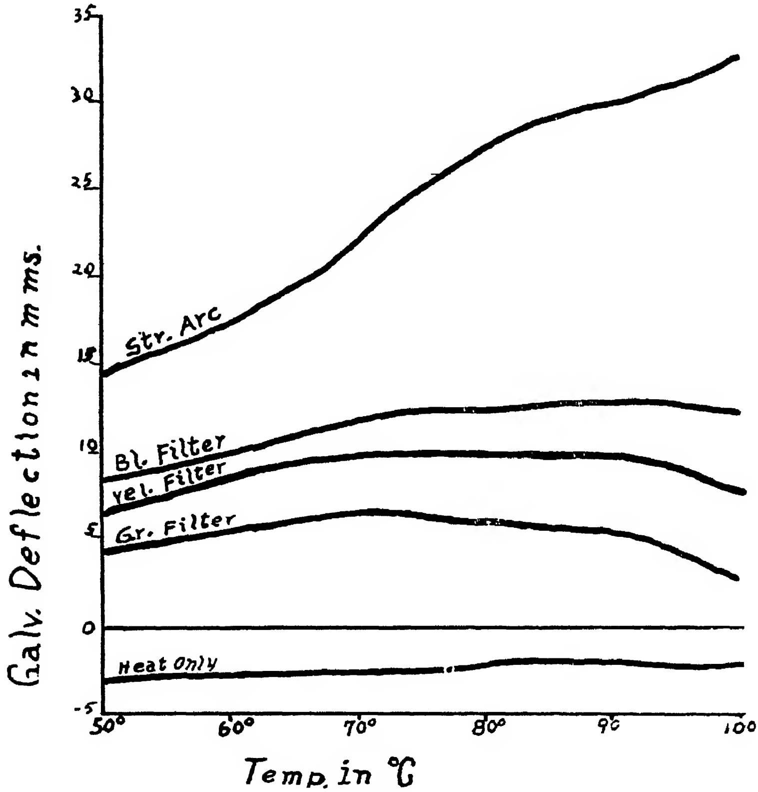

Fig. 6.

Conclusions

The conclusions to be drawn from these results are summarized as follows; (1) The sensitivity was generally increased by evacuation. (2) Sometimes this increase is mainly just a shift. (3) The ultra violet showed considerable actino effect for all cells but one, decreasing with increasing temperature. (4) The responses to the

blue filter were stronger in all cases then those of the yellow, showing that the shorter wave lengths increased the actino effect. (5) The sensitivity of the cells decreased at higher temperatures for all colors.

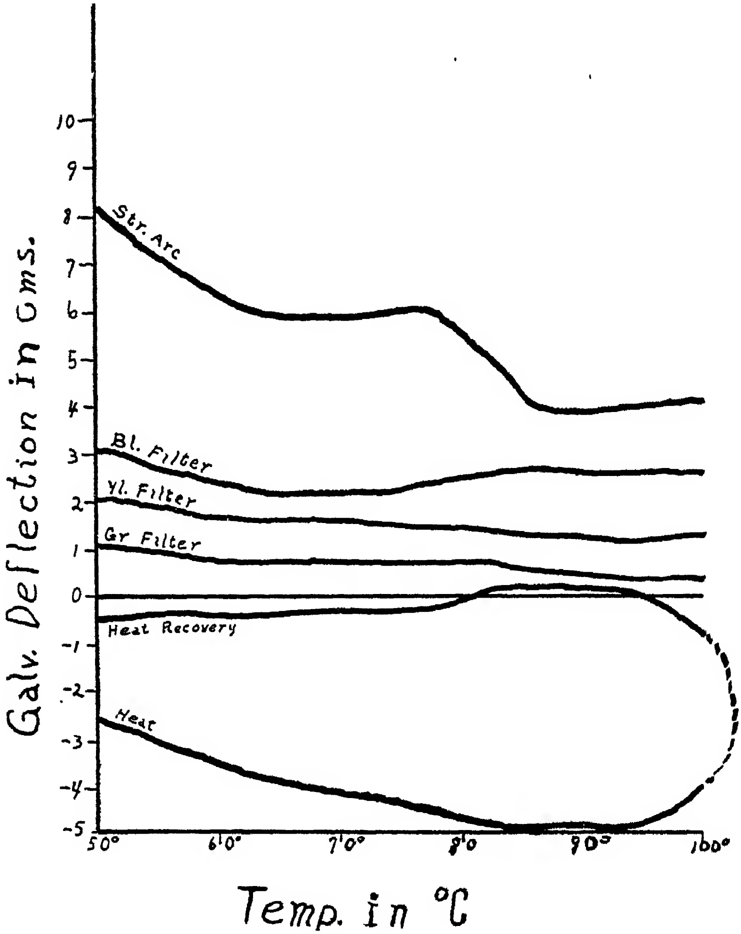

Fig. 7.

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A PRELIMINARY KEY TO THE HERBACEOUS DICOTYLEDONS OF THE CHEROKEE STRIP OF SOUTHEAST KANSAS

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This key, based as far as possible on leaf and stem characteristics, includes about 200 of the wild or uncultivated plants of the Cherokee strip of southeast Kansas which have been found and identified by the author. The scientific names have been taken from Gray's Manual of Botany[4] and Britton's Manual of Flora of the United States and Canada.[2] In most cases the common names are those used in the locality where the plants were found. In other cases they are taken from Gray[4], Britton[2], or Georgia[3].

The territory is described by George I. Adams[1] as being a strip of land mainly between the Neosho and Spring Rivers including most of Cherokee county and parts of Labette, Crawford and Bourbon counties, in Kansas.

This key has been used and revised but is not to be thought of as being complete. It is offered with the hopes that it may be of use to others in similar attempts for their regions or possibly for entire states.

The key is essentially dichotomous in that you choose one or two or rarely more parallel statements regarding a given point. If the statement is true proceed to the next immediately following. If not true go to the next statement bearing the same number.

Let us take a common plant as an example and identify it. We shall take the broad leaved plantain having the red leaf stem. The stem is not twining, climbing, prostrate or floating but comes under the group in the second statement numbered 1 which reads "Stems upright or underground". Upon examination we find that all leaves are radical, they are entire and ribbed but not narrow so we drop down to the second part of Number 6 "Leaves broad". The petiole is red not green so we see that our plant is Plantago rugelii, the red leaved plantain.

1. Stems not upright nor underground, but twining, climbing, prostrate or aquatic.
  2. Stems twining or climbing.
    3. Leaves green.
      4. Leaves opposite ------------------ Humulus lupulus, Hop
      4. Leaves whorled -------------- Galium aparine, Bed straw.
      4. Leaves alternate.
        5. Leaves simple.
          6. Leaves heart shaped.
            7. Leaves lobed. ---- Ipomoea hederacea, Wild morning glory.

7. Leaves not lobed. Ipomoea purpurea, Common morning glory.

6. Leaves halberd shaped.

7. Stems smooth. Convolvulus sepium, Hedge bindweed.

7. Stems rough and woody appearing. Polygonum convolvulus, Black bindweed.

5. Leaves compound. -- Strophostyles pauciflora, Wild bean.

3. Plants not green.

4. Color pale yellow. ---- Cuscuta arvensis, Dodder, Love vine.

4. Color orange. ------ Cuscuta gromerata, Dodder, Love vine.

2. Stems usually prostrate or floating.

3. Plants aquatic.

4. Leaves entire. ---------- Jussiaea diffusa, Primrose willow.

4. Leaves finely divided. Ranunculus aquatilis, Water crowfoot.

3. Plants not aquatic.

4. Leaves simple.

5. Stems fleshy.

6. Stems thorny. ------ Opuntia polyacantha, Prickly pear.

6. Stems not thorny.

7. Leaves oval. ------------ Portulaca oleracea, Purslane.

7. Leaves linear.

8. Leaves few (2 or 4). Claytonia virginica, Spring beauty.

8. Leaves many. ---- Sedum pulchellum, Crowfoot moss.

5. Stems not fleshy.

6. Juice milky.

7. Leaves whorled. -- Mollugo verticillata, Carpet weed.

7. Leaves alternate. Krigia occidentalis, False dandelion.

7. Leaves opposite.

8. Leaves large (5-12 cm. long). Acerates viridiflora, Green milkweed.

8. Leaves small. -- Euphorbia maculata, Milk purslane.

6. Juice not milky.

7. Stems hairy in lines. Stellaria media, Chickweed, Starwort.

7. Stems not hairy in lines.

8. Leaves opposite.

9. Plants small (20 cm. or less). Houstonia minima, Bluets.

9. Plants large.

10. Leaves linear (5-10 cm. long). Asclepias tuberosa, Butterfly weed.

10. Leaves oblong (1-3 cm.). Cerastium vulgatum, Mouse ear chickweed.

10. Leaves lobed. -- Verbena bracteosa, Vervain.

8. Leaves alternate.
 9. Leaves shield shaped.
 Malva rotundifolia, Common mallow.
 9. Leaves lanceolate.
 Polygonum aviculare, Knot weed, Goose grass.
 9. Leaves obovate or spatulate.
 10. Stems and leaves woolly white. Antennaria neglecta, Everlasting, Woman's tobacco.
 10. Stems and leaves not woolly white.
 11. Stems spiny.
 Amaranthus spinosus, Spiny careless weed.
 11. Stems not spiny.__ Amaranthus blitoides, Careless weed, Tumble weed.
4. Leaves compound.
 5. Leaves palmately divided.
 6. Leaves 3-cleft (trifoliate).
 7. Leaflets obcordate. Oxalis stricta, Yellow wood sorrel
 7. Leaflets wedge obovate.
 Trifolium procumbens, Hop clover.
 6. Leaves 5-cleft.
 7. Leaf margins serrate. ______ Potentilla canadense, Five fingers, Cinquefoil.
 7. Leaf margins dentate. __________ Potentilla pumila. Five fingers, Cinquefoil.
 5. Leaves pinnately divided.
 6. Stems armed with tiny thorns. __ Schrankia uncinata, Sensitive plant.
 6. Stems not armed with tiny thorns. Astragalus caryocarpus, Prairie apple, Ground plum.
1. Stems upright or underground.
 2. Some or all leaves radical.
 3. All leaves radical.
 4. Leaves entire, at least not deeply lobed.
 5. Leaves ribbed.
 6. Leaves narrow.
 7. Flower stalk grooved. ________ Plantago lanceolata, Rib grass.
 7. Flower stalk not grooved.
 8. Leaf margins entire. ________ Plantago aristata, Bracted plantain, Western buckhorn.
 8. Leaf margins slightly toothed. Plantago virginica, Narrow leaved plantain.
 6. Leaves broad.
 7. Petiole green. Plantago major, Broad leaved plantain.
 7. Petiole red. Plantago rugelii, Red leaved plantain.

5. Leaves not ribbed.
  6. Leaves 2-4 cm. long.-- Viola papilionacea, Common violet.
  6. Leaves over 5 cm long. ---------- Dodecatheon meadia, Turkey snout, American cowslip.
4. Leaves lobed or compound.
  5. Leaves palmately divided.
    6. Leaves lobed. ------------ Viola pedata, Bird's foot violet.
    6. Leaves compound.
      7. Leaflets obcordate. -- Oxalis violacea, Violet wood sorrel.
      7. Leaflets obovate with serrate margins. Fragaria virginica, Wild strawberry.
  5. Leaves pinnately divided.
    6. Juice milky.
      7. Leaves lyrate.---- Krigia occidentalis, False dandelion.
      7. Leaves deeply pinnatifid into narrow segments. Taraxacum erythrospermum, Red seeded dandelion.
      7. Leaves pinnatifid into broad segments. Taraxacum officinale, Common dandelion.
    6. Juice not milky. ------------ Arabis virginica, Rock cress.

3. Some leaves radical.
  4. Stem leaves alternate.
    5. Leaves spiny.
      6. Juice milky.
        7. Midribs of leaves spiny beneath. ---- Lactuca scariola, Prickly wild lettuce.
        7. Midribs not spiny. -------- Sonchus asper, Sow thistle.
      6. Juice not milky.
        7. Stems winged. -------- Cirsium lanceolatum, Bull thistle.
        7. Stems not winged.
          8. Leaves whitish above. ---------- Cirsium undulatum, Common thistle.
          8. Leaves green above.
            9. Leaves deeply pinnatifid. -------- Cirsium discolor, Plumed thistle.
            9. Leaves sparingly pinnatifid. ---- Cirsium altissimum, Tall thistle.
    5. Leaves not spiny.
      6. Leaves simple, not deeply lobed.
        7. Leaves ribbed. ------ Cacalia tuberosa, Indian plantain.
        7. Leaves not ribbed.
          8. Stem joints enlarged.
            9. Leaf margins wavy. ---- Rumex crispus, Curly dock.
            9. Leaf margins not wavy.
              10. Leaves broad. -- Rumex obtusifolius, Sour dock
              10. Leaves narrow. --Rumex patientia, Patience dock.

8. Stem joints not enlarged.
9. Juice milky.
10. Plants small (6 cm. or less). ---- Krigia occidentalis, False dandelion.
10. Plants large. -------- Lactuca canadensis, Wild lettuce.
9. Juice not milky.
10. Leaves round ovate.
11. Leaves and stem densely woolly with branched hairs. Verbascum thapsus, Mullen.
11. Leaves densely woolly beneath.---- Arctium minus, Burdock.
11. Leaves slightly hairy beneath. -- Lappula virginiana, Beggar lice.
10. Leaves heart shaped. -- Viola pubescens, Yellow violet.
10. Leaves narrowly lanceolate.
11. Leaves slightly woolly. -- Oenothera rhombipetala, Evening primrose.
11. Leaves and stems bristly hairy. Erigeron canadensis. Mule's tail.
10. Leaves ovate or oblong lanceolate.
11. Leaves sinuate-pinnatifid. ------ Oenothera speciosa. Evening primrose.
11. Leaves dentate.
12. Flowers yellow.--------------- Oenothera biennis, Evening primrose.
12. Flowers pink. ---------------- Gaura parviflora, Evening primrose.
12. Flowers white, turning pink with age. Gaura biennis, Evening primrose.
6. Leaves compound or deeply lobed.
7. Plants with a pungent odor. ------------ Achillea millefolium. Common yarrow.
7. Plants with little or no pungent odor.
8. Leaves palmately parted.
9. Leaves 5-7 cleft. ------ Anemone canadensis, Anemone.
9. Leaves 3-5 cleft.
10. Terminal division longstalked. Ranunculus fascicularis, Early crowfoot.
10. Terminal division not longstalked. Delphinium azureum, Larkspur.
8. Leaves pinnately parted.
9. Stem leaves simple.
10. Stem leaves arrow shaped. ---- Capsella bursapastoris. Shepherd's purse.

10. Stem leaves not arrow shaped.
11. Petals present. ------ Lepidium virginicum, Peppergrass.
11. Petals absent. -------- Lepidium apetalum Peppergrass.
9. Stem leaves compound. -- Sisymbrium canescens, Hedge mustard.
4. Stem leaves opposite.
5. Stem leaves ovate or round ovate, crenate toothed. Scutellaria versicolor, Skull cap.
5. Stem leaves oblanceolate or ovate, mostly entire. Scutellaria integrifolia, Skullcap.
2. No leaves radical.
3. Leaves opposite or whorled.
4. Juice milky.
5. Leaves stipuled.
6. Leaves with white markings. ---- Euphorbia marginata, Snow-on-the-mountain.
6. Leaves with red markings. -- Euphorbia preslii, Spurge.
5. Leaves not stipuled.
6. Leaves broad.
7. Leaves soft downy to smooth.
8. Leaves 5-10 cm. long. -------- Acerates viridiflora, Green milkweed.
8. Leaves 8-12 cm. long. -------- Asclepias speciosa, Showy milkweed.
8. Leaves 10-20 cm. long. -------- Asclepias syriaca, Common milkweed.
7. Leaves velvety beneath. ------ Asclepias purpurascens, Purple milkweed.
6. Leaves linear.
7. Leaves whorled. ---- Asclepias verticillata, Milkweed.
7. Leaves not whorled. -------- Apocynum cannabinum, Indian hemp, Dogbane.
4. Juice not milky.
5. Stem 4-wing angled. -- Sabatia angularis, Quinine flower.
5. Stem square.
6. Leaves aromatic.
7. Leaves lobed. ------ Leonurus cardiaca, Motherwort.
7. Leaves not lobed.
8. Leaves heart shaped to oblong. ---- Nepeta cataria, Catnip.
8. Leaves lanceolate or ovate.
9. Leaf base rounded. Teucrium canadense, Woodsage

9. Leaf base not rounded.
10. Leaves pale green. ------ Physostegia denticulata, False dragon head.
10. Leaves dark green. -- Monarda fistulosa, Horsemint.
6. Leaves not aromatic.
7. Leaves incised.
8. Leaves regularly and deeply incised. -- Verbena officinalis. European vervain.
8. Leaves irregularly incised.-- Verbena canadensis, Verbena.
7. Leaves serrate or dentate.
8. Plants smooth.
9. Leaves lanceolate and petioled. ------ Verbena hastata, Blue vervain.
9. Leaves linear and sessile. ------ Verbena angustifolia, Vervain.
8. Plants covered with fine hairs.
9. Leaves petioled. -- Verbena urticaefolia, White vervain.
9. Leaves sessile. -------- Verbena stricta, Hoary vervain.
5. Stems round or nearly so.
6. Stem joints enlarged.
7. Stems grooved. ---- Cerastium nutans, Mouse-ear chickweed.
7. Stems not grooved.
8. Plants sticky. -- Silene noctiflora, Night flowering catchfly.
8. Plants not sticky.
9. Leaves broad. ---------------- Oxybaphus nyctagineus, Wild four o'clock.
9. Leaves narrow. ------ Silene dichotoma, Catchfly pink.
6. Stem joints not enlarged.
7. Leaves connected by stipules. ---- Diodia teres, Buttonweed.
7. Leaves not connected by stipules.
8. Leaves lobed or compound.
9. Leaves 5-lobed. ---- Geranium carolinianum, Cranesbill.
9. Leaves deeply 3-lobed. -------------- Ambrosia trifida, Giant ragweed, Horseweed.
9. Leaves 3-palmately compound. -------- Oxalis grandis. Yellow wood sorrel.
9. Leaves pinnately parted.
10. Leaves dotted with clear dots. ---- Dyssodia papposa. Fetid marigold.
10. Leaves not dotted with clear dots.
11. Leaves 3-5 divided, leaflets sharp serrate. Bidens frondosa, Beggarticks.
11. Leaves variable, 0-7 divided, incisely serrate or lobed.
12. Leaves hairy.
13. Some leaves whorled. Dipsacus laciniatus, Teasel.

13. Some leaves alternate.
14. Leaves thin. -- Ambrosia artemisiifolia, Roman wormwood.
14. Leaves thickish. Ambrosia psilostachya, Ragweed.
12. Leaves not hairy.
13. Leaflets linear. ------ Coreopsis tinctoria, Tickweed.
13. Leaflets ovate-lanceolate, base wedge shaped. -- Bidens bipinnata, Spanish needles.
8. Leaves neither lobed nor compound.
9. Leaves dotted with clear dots. Hypericum punctatum, St. John's wort.
9. Leaves not dotted with clear dots.
10. Leaves and stem resinous. Lythrum alatum, Loosestrife.
10. Leaves and stems not resinous.
11. Plants small (3-10 cm. high). Houstonia mimina, Bluets.
11. Plants large (10 cm. or more). Gentiana puberula, Gentian.
3. Leaves alternate.
4. Juice milky.
5. Leaves pinnatifid. ------------ Pyrrhopappus carolinianus, False dandelion.
5. Leaves not pinnatifid.
6. Leaf margins entire.
7. Plants small (10-20 cm. high). Specularia leptocarpa, Venus' looking glass.
7. Plants large (over 2.5 dm.) -------- Asclepiodora viridis Milkweed.
6. Leaf margins toothed. -- Campanula americana, Bluebell.
4. Juice not milky.
5. Leaves compound or deeply lobed.
6. Leaves palmately divided.
7. Leaves 3-parted.
8. Leaflets and stems dotted. ------ Psoralea lanceolata, Psoralea
8. Leaflets and stems not dotted.
9. Stipules present.
10. Bracts large and conspicuous. Baptisia bracteata, Bracted false indigo.
10. Bracts small.
11. Leaflets lanceolate. -------- Baptisia villosa, False indigo.

11. Leaflets oblong.
12. Flowers white or cream color.
Baptisia leucantha, False indigo.
12. Flowers blue. Baptisia australis, Blue false indigo.
9. Stipules none. -------- Cleome serrulata, Stinking clover.
7. Leaves more than 3-parted.
8. Leaflets large and lobed. Podophyllum peltatum, May apple.
8. Leaflets small and entire. -- Lupinus perennis, Wild lupine.
6. Leaves pinnately divided.
7. Stems hollow.
8. Stems purple streaked. ------------------ Cicuta maculata,
Water hemlock, Spotted cowbane.
8. Stems not purple streaked.
9. Leaf divisions thread like. ---- Ptilimnium capillaceum,
Mock bishop's weed.
9. Leaf divisions lanceolate. ---- Daucus carota, Wild carrot.
7. Stems not hollow.
8. Leaves regularly divided.
9. Plants with a strong odor.
10. Leaflets three.
11. Leaflets closely serrate. -------- Melilotus officinalis,
Yellow sweet clover.
11. Leaflets not closely serrate. -------- Melilotus alba,
White sweet clover.
10. Leaflets more than three. Anthemis cotula, Dog-fennel.
9. Plants without strong odor.
10. Plants resinous. ----- Silphium laciniatum Rosin weed.
10. Plants not resinous.
11. Leaflets three.
12. Leaves nearly sessile, faintly veined.
Hosakia americana, Hosakia.
12. Leaves petioled, strongly veined.
Desmodium canadense, Tick trefoil.
11. Leaflets more than three.
12. Leaves finely dissected.
Corydalis aurea, Golden corydalis.
12. Leaves not finely dissected.
13. Leaflets 20 or more.
14. Leaflets sensitive. ------ Cassia chamaecrista.
Partridge pea, False sensitive plant.
14. Leaflets not sensitive.
15. Leaflets whitened. ---- Amorpha canescens,
Lead plant.
15. Leaflets not whitened. Amorpha microphylla,
Lead plant.

13. Leaflets less than 20, but more than 3.
14. Stem grooved. ------ Lepachys columnaris, Cone flower.
14. Stem not grooved.
15. Leaflets narrowly linear.
Petalostemum multiflorum, Prairie clover.
15. Leaflets linear to oblong.
Petalostemum multiflorum, Prairie clover.
8. Leaves irregularly divided. -------- Sisymbrium officinale, Hedge Mustard.

5. Leaves simple, not deeply lobed.
6. Leaves or stems prickly.
7. Plants with a rank or unpleasant odor.
8. Leaves pinnatifid. ------ Solanum rostratum, Buffalo bur.
8. Leaves oblong or ovate and toothed or lobed.
Solanum carolinense, Horse nettle.
8. Leaves lanceolate and nearly entire.
Solanum elaeagnifolium, White horse nettle.
7. Plants without a rank or unpleasant odor.
8. Leaves entire. Amaranthus spinosus, Spiny careless weed.
8. Leaves pinnatifid. ----- Cirsium arvense, Canadian thistle.
6. Neither leaves nor stems prickly.
7. Stem joints enlarged and sheathed.
8. Leaves halberd shaped. -- Rumex acetosella, Sheep sorrel.
8. Leaves ovate or oblong. ---------- Polygonum orientale, Prince's feather.
8. Leaves linear or lanceolate.
9. Leaves marked with dark spots.
Polygonum persicaria, Lady's thumb.
9. Leaves not so marked.
10. Leaves small (2 cm. long or less).
Polygonum prolificum, Smartweed.
10. Leaves large.
11. Juice very acrid and peppery.
Polygonum hydropiper, Smartweed.
11. Juice not very acrid and peppery.
Polygonum pennsylvanicum, Smartweed.
7. Stem joints not sheathed and enlarged.
8. Leaves broad.
9. Stipules present.
10. Plants small (3dm. or less).
11. Plants hairy. Hibiscus trionum, Flower of an hour.
11. Plants not hairy.
12. Leaves round cordate.
Callirrhoe digitata, Poppy mallow.

12. Leaves suborbicular to linear oblanceolate.
Viola rafinesquii, Wild pansy.
10. Plants large.
11. Plants velvety. ------ Abutilon theophrasti, Velvet weed.
11. Plants not velvety. ------ Crotalaria sagitalis, Rattle box.
9. Stipules none.
10. Leaves lyrate. ---------- Brassica nigra, Black mustard.
10. Leaves 3-lobed.
11. Plants with a strong odor.
12. Bur with few prickles. ---- Xanthium pennsylvanicum, Cocklebur.
12. Bur with many prickles. ---------- Xanthium italicum, Cocklebur
11. Plants with no strong odor.
12. Leaf margins coarse serrate. ------ Rudbeckia triloba, Coneflower.
12. Leaf margins nearly entire. ---- Ambrosia bidentata, Common ragweed.
10. Leaves pinnately cleft. ---- Radicula sinuata, Water cress.
10. Leaves neither lyrate, 3-lobed nor pinnate.
11. Plants rough.
12. Lower leaves heart shaped.
13. Plants slender. -------------- Aster azureus, Aster.
13. Plants stout. -------- Helianthus annuus, Sunflower.
12. Lower leaves not heart shaped.
13. Leaves light green, petioles long.
Amaranthus retroflexus, Common careless weed.
13. Leaves dark green, petioles short.
Vernonia baldwinii, Ironweed.
11. Plants smooth.
12. Plants small (5 dm. or less). ------ Solanum nigrum, Common nightshade.
12. Plants large.
13. Leaves thin, flowers not showy.
14. Stems reddish color, seeds in berries.
Phytolacca decandra, Pokeweed.
14. Stems light green, seeds not in berries.
Chenopodium hybridum, Mapleleaved goosefoot.
13. Leaves thick, flowers large and showy.
Datura stramonium, Jimson weed.
8. Leaves narrow.
9. Part or all leaves spatulate.
10. Leaves pale green.
11. All leaves spatulate. ---------- Amaranthus graecizans, Tumbleweed.
11. Only part of leaves spatulate.
Chrysanthemum leucanthemum, Oxeye daisy, Shasta daisy.

10. Leaves dark green. ---------- Rudbeckia fulgida, Coneflower.
9. No leaves spatulate.
10. Plants whitish and granular. ---------- Chenopodium album, Lamb's quarters.
10. Plants not whitish and granular.
11. Stems smooth.
12. Leaf margins entire.
13. Leaves sessile and clasping. -- Solidago amplexicaulis Goldenrod.
13. Leaves not sessile and clasping.
14. Leaves 3-ribbed. -- Solidago canadensis, Goldenrod.
14. Leaves not 3-ribbed.
15. Branchlets only on the upper side of branches. Aster ericoides, Aster.
15. Branchlets, if any, not all on upper side of branches.
16. Upper leaves linear or threadlike. Helianthus orgyalis, Sunflower.
16. Upper leaves not linear and threadlike. Physalis longifolia, Ground cherry.
12. Leaf margins toothed.
13. Plants aromatic. ---------- Chenopodium ambrosioides. American wormseed, Vermifuge.
13. Plants not aromatic.
14. Juice milky. ---- Lobelia cardinalis, Cardinal flower.
14. Juice not milky.
15. Leaves 3-ribbed or 3-nerved.
16. Leaves with a strong midrib. -- Solidago rigida, Goldenrod.
16. Leaves with no strong midrib. Solidago serotina, Goldenrod.
15. Leaves not 3-ribbed or 3-nerved.
16. Leaves gradually narrowed to entire base. Solidago (sp.?), Goldenrod.
16. Leaves not gradually to an entire base.
17. Leaves lanceolate or linear.
18. Plants resinous. ------ Grindelia lanceolata, Gumplant.
18. Plants not resinous.
19. Stems slender. ------ Solidago uniligulata, Goldenrod.
19. Stems stout. -- Vernonia crinita, Ironweed.
17. Leaves ovate to ovate lanceolate. Brauneria purpurea, Coneflower.
11. Stems rough, hairy or woolly.
12. Plants yellowish with a star-shaped pubescence. Croton texensis, Wild sage.
12. Plants not yellowish.

13. Leaves many, narrowly lanceolate. ------------ Liatris scariosa, Blazing star.

13. Leaves fewer, not narrowly lanceolate.

  14. Plants with short stiff hairs. ------------ Physalis virginiana, Ground cherry.

  14. Plants with tiny close hairs. ------------ Erigeron ramosus, Daisy fleabane.

  14. Plants rough bristly. ---- Rudbeckia hirta, Black-eyed Susan.

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THE RELATION BETWEEN GESTALT PSYCHOLOGY AND THE BEHAVIORISTIC PSYCHOLOGY OF LEARNING[1]

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The person who presents a theoretical paper at a psychological meeting nowadays almost needs an elaborate alibi to justify his course. My own alibi is as follows: one may note among the psychologists in this country a widespread conviction that Gestalt psychology has much to contribute to American psychological work; and yet, one may note an almost equally general perplexity as to what the contribution may be. I do not, of course, refer to the fact that there have been relatively few whole-souled converts to the Gestalt position. I refer rather to the fact that, even among those who profess considerable faith in Gestalt psychology, there has been only the slowest and most difficult assimilation of Gestalt principles. This situation gives the occasion for this paper. It is not my purpose to advocate the unconditional surrender of any other school to Gestalt psychology, but to point out that Gestalt psychology has been dealing with problems closely related to the work of American psychologists, and that Gestalt psychology has been gathering hypotheses which, when integrated with the work of American psychology, can prove of almost epoch-making significance for American experimental work.

Hence, I have chosen to discuss the relation between Gestalt psychology and the behavioristic psychology of learning. Incidentally, let me state that throughout this paper, the terms "behaviorism" or "behavioristic psychology" refer merely to what has been called methodological behaviorism. By that I mean the position of those who insist that the discussion of experimental work be kept in terms of objectively measurable behavior, and who avoid the discussion of questions of "experience", whatever their views on its existence or non-existence. My choice of this topic has been guided by the following considerations: (1) Behaviorism, in the sense indicated above, may be regarded, perhaps, as the most characteristic and prevalent trend in American psychology. (2) Behaviorism has been regarded by many as having less relationship to Gestalt than any other school of American psychology. If the relation of Gestalt psychology to behaviorism can be made clear, then the implications of Gestalt psychology for other schools may easily be discerned. (3) Of all the problems studied by American psychology, learning is perhaps the problem stressed most both as regards the conditions affecting it and as regards the problem of the physiological basis of learning. In America

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the belief has been prevalent that Gestalt psychology has nothing to contribute in this field. Too many American psychologists regard Gestalt psychology as being concerned with nothing but the "wholeness" of perceptual units, and as being almost exclusively an attack on certain interpretations of introspective analysis. It is easy to understand how this belief might delay utilization of Gestalt work, for American psychologists have found no great dividends in the field of perception, and have generally come to the conclusion that the field has small potentialities. In contrast with this too common view, my purpose is to indicate that Gestalt psychology has been led to an unusually fruitful consideration of the problems which constitute the very heart of behavioristic work.

However, let me disavow any intention of recommending the principle of insight. I make this disavowal because, first, too many American psychologists regard insight as the only principle of learning which Gestalt psychology stresses, and because, second, I share the feeling that the principle of insight is a negligible contribution. By insight I understand Gestalt psychology to mean the recognition by the subject of the relationships of different perceived objects—a conscious appreciation of the significance of different parts of the experienced field relative to one another. Insight, as thus understood, represents merely the end result of learning. It does not explain what factors govern the development of this appreciation of relationships. Hence, the term merely designates the products of learning, and has no explanatory value with reference to learning.

The significence of Gestalt psychology for the behavioristic interpretation of learning seems to me to spring rather from a number of other principles of Gestalt psychology which have secured but limited recognition. To demonstrate this, let us review a body of well-established experimental facts. The first are from observations in Pavlov's laboratory. (Pavlov, 1926). It was found that after the development of a conditioned salivary reflex to some one particular stimulus, the dog would make the same response to other stimuli which had never actually been used during training, but which were roughly similar to the stimulus which had been used previously. For example, a dog trained to salivate to a note of 1000 double vibrations would salivate to an almost equal degree to other notes of roughly the same pitch. In other sensory fields analogous results were found.

In the field of so-called trial and error learning, experiments of Lashley (1929), Kluever (1931), and others have demonstrated the same phenomenon. Thus, in experiments with rats and monkeys, it was found that after developing certain habits of visual discrimina-

tion, the experimenters could substitute quite a range of forms for those which had been used in the training period, and yet secure the same responses. Thus, after the animals had been trained to make a positive response to a solid square and a negative response to a solid circle, the substitution of outlines of these figures for the solid forms did not interfere with the discrimination.

Another, and a rather odd, illustration comes from an experiment by Hunter (1918). Rats had been trained, in a simple T-maze, to turn right to a whistle and left to silence. When this habit was established, light and darkness were substituted for the two stimuli of the training period. The result was that some of the animals reacted in a definite and regular manner, going right when the light was presented, and left when darkness was used.

We may cite evidence even from Watson (1921). I refer to the experiment in which a conditioned fear response was established in an infant by producing a loud sound at the moment when the infant reached for a white rat. It was found that after the period of conditioning, the child would make similar, and almost equally intense avoiding reactions to the sight of rabbits or dogs, and to the touch of a fur collar.

All of the above experimental data illustrate the phenomenon which has been called **equivalence of stimuli.** This phenomenon is relatively rarely mentioned in behavioristic literature, and is virtually unutilized in the behavioristic interpretation of learning. Before we turn to the theoretical interpretations, however, let us review some further evidence. It has been proven quite conclusively that, after training has been given, if the stimulus is applied to a region of the sensory surface which has never been utilized in training, this shifted stimulus still evokes the same response. Of such a nature are Lashley's (1924) experiments in which the rats were trained to make certain discriminations with one eye blindfolded and tested with the blindfold shifted to the other eye. In the study by Franz (1931), human subjects were trained to identify a number of geometrical forms presented to a certain peripheral visual region. After such training, the presentation of the same forms to other regions of the periphery gave a similar degree of recognition. The above data illustrates what might be called **equivalent stimulation.**

Now let us follow such data one step further. Not only may the phenomena of **equivalent stimuli** and **equivalent stimulation** find expression after a habit has been developed or a conditioned response set up, but through the entire course of training the stimuli used may vary from those used in any previous application of the stimuli, and yet the habit will be formed regardless. When a homing pigeon is

being trained to return to its cote, for instance, it does not get the same stimulation twice, except in the rarest instances. The angle of approach, prevailing atmospheric conditions, etc., all cause the perceived situation to vary. Similarly, it is certain that a rat running a maze does not receive the same visual, kinesthetic, or tactual stimulation on successive trials. In view of the widespread occurrence of these phenomena, therefore, one point which I would stress is that the phenomena of equivalence, rather than being rare and insignificant, must be taken into consideration as an integral and fundamental feature of learning.

For completeness' sake, we should turn now to a consideration of an analogous phenomenon found at the effector end of the behaviorist's stimulus-response circuit. It is possible to develop relative to that end the principle of **equivalence of response.** I give but one illustration of this phenomenon. An individual is trained by repeated trials to hum or sing a certain melody. His pitch is always given him, and the practice always occurs in the same key. With the habit established, however, the subject will be equally capable of reproducing the melody in other keys, even in cases where he does not realize that he is making the change. The significant feature of this case is that at every point in the melody he will make responses with his vocal apparatus that he had never made at that point before.

But let us temporarily disregard this phenomenon of **equivalence of response,** and confine our attention to the stimulus end of the circuit. Let us consider now the implications of such date as these for the interpretation of learning, and particularly for the problem of the physiological basis of learning. If we turn to the behavioristic literature, we find only the slightest mention of the concepts of **equivalent stimuli, equivalent stimulation,** or **equivalence of response,** or of the data to which these concepts refer. It would seem that observations of this sort have little theoretical significance for psychology. And in fact, a recent review by Robinson (1930) of Koehler's "Gestalt Psychology" almost explicitly states this. As Robinson cleverly phrases it, "The fact that the city child calls his first sheep a 'bow-wow' is hardly ground for starting a new school of psychology." Perhaps Robinson is right with regard to schools, but I wish to emphasize this:—the fact that the city child calls his first sheep a "bow-wow" is sufficient ground for making some radical revision in the behavioristic psychology of learning.

Let us, then, try to determine the significance of these data which the behaviorist has practically neglected. Largely on the basis of studies of peripheral nerves and of spinal reflex arcs, the behaviorist has built up a theory of learning as being dependent upon the develop-

ment of certain neural pathways between the receptor and effector organs. This principle may be said to be the keynote of the behavioristic theory of the physiological basis of behavior. It is a doctrine which has decidedly affected his choice of experimental problems. The Gestalt psychologists (see especially Koehler, 1929, chs. V, VIII, and IX), on the other hand, have formulated their studies of learning on the basis of suggestions derived from their work in perception. As a consequence, they have been led to recognize as existing at every turn the phenomena of **equivalence of stimuli** and of **equivalent stimulation.** The consequence of this has been that the problem of the factors governing **equivalence of stimuli** has come to be a fundamental feature of the Gestalt attack, whereas behaviorists have hardly noticed the phenomenon. Furthermore, as a result of stressing this problem, Gestalt psychology has been led to see the impossibility of interpreting learning as dependent upon any fixed and invariable routes in the nervous system, and has been driven to develop a theory of the nervous system as a system of dynamical stresses. Or, in other words, Gestalt psychology has been led to consider that the nervous system operates essentially by processes whose properties are determined by certain principles of physiological organization, and not by the existence of any relatively independent pathways of lowered resistance. It is partly as a consequence of the introduction of expressions like these that American psychologists have found it difficult to follow Gestalt treatments. There is too little realization of the fact that the concepts of dynamical equilibrium, fields of force, dynamical stress, etc., may be just as consistent with the best principles of natural science as the anatomical concepts upon which behaviorism has based its interpretation of learning. As a matter of fact, these very principles of nervous activity are now finding brilliant support in the work of Franz, Lashley (1930), and others.

In conclusion, I call attention to the fact that I have discussed but one or two of the points of contact between Gestalt and behaviorism. If time did not forbid it would be possible to show that Gestalt and behaviorism touch as significantly at many other points in the field of learning. There is time, however, merely to enumerate some of the problems which Gestalt psychology has selected as fundamental to learning:

(1) How does the arrangement of the situation presented to the subject determine the ease of learning?

(2) How does the attitude of the learner enter in as one of the features of organization of the learning situation?

(3) In the course of retention, do the memory traces tend to change in certain definite ways dependent upon the characteristics of the organizations to which they belong, and if so, what are these ways?

(4) How is recall affected by the relation between the organization which the recall situation tends to yield and the organization which the memory traces provide?

It is of course true that some of the problems of learning stressed by Gestalt are merely rephrasings of the problems of learning of behaviorism. In other cases it can well be said that the principles of Gestalt have led to the formulation of problems of learning which promise to facilitate much more penetrating and fruitful experimental work. Because of such considerations as these, then, it would seem that the best interests of American psychology call for a very definite reconsideration of their basic principles in the light of Gestalt work.

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AN EXPERIMENTAL STUDY OF RHYTHMS

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The purpose of the present study was to discover whether simple motor performances show rhythms. The original performance consisted of having college students trace blindfolded a simple maze which had no cul de sacs, but which did have regular small niches along the sides of the groove. Since this performance involved learning, we also used an even more simple apparatus, a square tracing board having smooth grooves. The repetition of similar patterns in the time curve of the particular performance was taken as evidence of the existence of a rhythm.

In interpreting the curves there were several points which gave more significance to these rhythms. These were major slants which were slopes from a high point to a low point, and from this low point to the next low point; major curves which were rhythmic patterns containing high points at the middle and low points at the beginning or the end; major resting places which were places where the subjects seemed to have reached a so-called "plateau of performance", in which the time for several trials was the same.

An effort was also made to see if the curves of performance showed "initial" or " end spurts", but none was discovered. The introspective reports of the subjects as to feelings of fatigue and of rested feelings showed no correlation with the speed of performance.

Despite the learning, which was increasing, the subjects showed little or no improvement in visual imagery.

The curves showed major rhythms of approximately equal length throughout the curve for each trial. When the rhythm shortened, it seemed shorter only by the amount of a minor rhythm. These rhythms seemed to persist for a considerable period of time. The general level of the curve may fall, but the form remains relatively constant. As time went on, the major high points dropped; the major rhythms spread out more as though the curve had been flattened. The major low points tended to disappear as learning increased. As the learning process went on, we began to find the appearance of major rest periods. These seemed to be periods in which the state of muscle coordination and nervous impulses were best balanced. These rest periods continued to grow larger until the rhythms seemed to disappear and the time curve became a relatively straight line.

To account for these rhythms we suggest the following explanation. Until the organism becomes relatively differentiated we find no evidences of rhythms. When, however, the neuro-muscular system becomes differentiated we find rhythms which seem to be influenced by

the oscillatory effect of the nerve impulses. There are both enhancing and inhibitory phases. When the inhibitory predominates, stimulation may produce stationary or even diminished results. When this phase is followed by the enhancing phase, further stimulation again becomes effective in raising the level of the curve of the performance.

The completed performance is the unit. The performance is directed in part by a goal which functions in the control of the determination of nerve fatigue. The organism compensates for a large expenditure of energy by relaxing. This tends to keep a certain balance or level of metabolic activity in the attainment of the goal tending to preserve the pattern until the goal is reached. It takes a long time to reach the goal, and the level of the curve rises and falls. Time is subordinate to the goal, and the performance is on the "all or none" principle as far as output is concerned.

INVESTIGATION OF RESONANCE CURVE WITH RESPECT TO VARIATION OF CAPACITY

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Abstract

An investigation of the possibility of using a vibrating variable condenser in a Hartley Oscillatory circuit to modulate the radio-frequency of the circuit, and a study of the effect of using the same type of condenser in a receiving circuit to modulate its radio frequency.

Introduction

This paper is the result of a piece of work started in September, 1930, by Professor Lyon and the writer at K. S. C. The work is still being carried on. In the revised edition of the Radio Manual by Sterling which came out about one year ago this same problem under the heading of "Frequency Modulation" is suggested with a method of procedure. Efforts to find out from the author or editor what work has been done on the subject so far have failed. This article did not reach us until this spring when a revised edition of the Manual was received. So this work was completed independent of all others.

At the present time the vacuum tube is the only means of modulation and amplification that has proved successful for work in radio telephony. With this in mind, it was decided to investigate the possibilities of a mechanical modulator operating by small variation of capacity in one of two coupled radio circuits.

When the three-electrode vacuum tube is used as an amplifier and the plate current is plotted as ordinates against the grid voltage, a characteristic curve is obtained. The useful portion of this curve lies between the points a. and b. Figure 1.

The resonance curve obtained by plotting the current against the capacity in an oscillating circuit of very low resistance, bears a certain resemblance to the tube characteristic of Fig. 1.

When one-half of this resonance curve is compared with that of the useful portion of the tube curve, it is seen that they are very similar. This suggests the possibility of placing a vibrating condenser in the circuit of an oscillator and obtaining effects of modulation and amplification analogous to those ordinarily obtained with the use of a tube. In other words, the construction of a mechanical modulator and, in some cases, amplifier, to replace the vacuum tube.

The object of this work was to determine (1) what effect a vibrating condenser, placed in a receiving circuit coupled with an os-

cillator, would have on the current in the circuit, and (2) what effect the vibrating condenser placed in the oscillator circuit would have upon the coupled receiving circuit.

From the wiring diagram it is seen that each circuit used consists of inductance, capacity and resistance in series, with an oscillating current flowing through them.

After a long series of derivations for circuits containing constant resistance, constant self-inductance, and constant capacity, (most of which but not all may be obtained from "Principle A. C." by Lawrence), we arrive at the following: I^2 is proportional to the reciprocal of C_2-C_1 when C_2 equals C^r plus delta C; C_1 equals C^r minus delta C. This is true only when working on the curve on both sides of the maximum values and very near the top.

The apparatus used for the transmitter was nothing more than a Hartley oscillator constructed for about eight meters and a fifty watt output. Later a much smaller tube was used with better results than the fifty watt. The main condenser of the circuit was paralleled by a specially constructed condenser, the capacity of which was varied by audio frequency.

This condenser was made by replacing the metallic diaphragn of a large Magna Vox with one of mica. Then placing a disc of tin foil on it to act as one plate, and placing a brass disc above it so that it was adjustable by a micrometer screw.

The receiving set was of the wave meter type built as near the same dimensions as the transmitter as possible. The readings were first made by observing a thermo-junction galvanometer. Later the galvanometer was replaced by a detector tube and head phone to study the modulation of the circuit.

Results and Conclusions

The first tests made were to determine whether or not the vibrating condenser, constructed as described, would affect the current flowing in the receiving circuit.

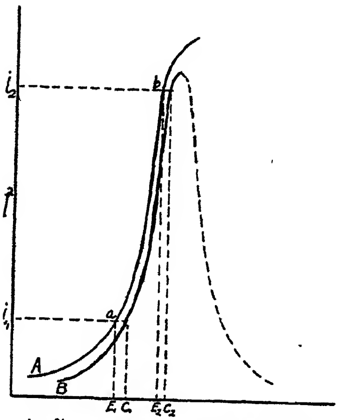
The circuit was arranged as shown in Figure 4 and tuned to the wave-length of the Hartley oscillator and adjusted until about half-scale deflection was obtained on the thermo-junction galvanometer. Then the condenser was set in vibration, and the reading of the galvanometer changed, showing that the set was thrown out of resonance.

The condenser was made to vibrate by connecting the input terminals to the output of the three-tube power amplifier box which was

connected to a 110 volts, 60 cycles, current through a potentiometer and modulation transformer not shown in figure.

The voltage on the input was then varied by means of potentiometer and the reading of the galvanometer was found to change, being greatest when maximum voltage was used and least when mini-

Figure 1.



A--Characteristic Curve of Tube
B--Resonance Curve.

Figure 2.

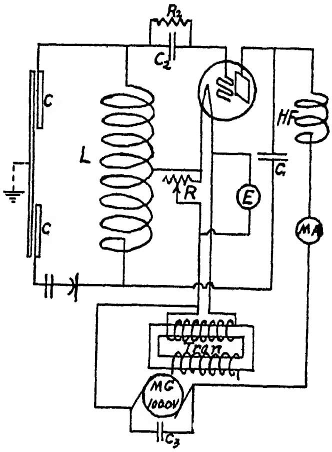


Figure 3.

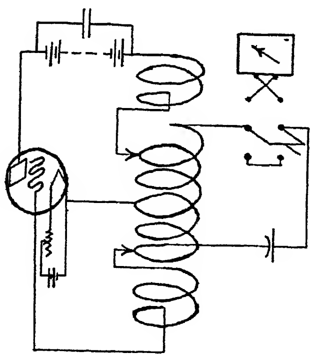
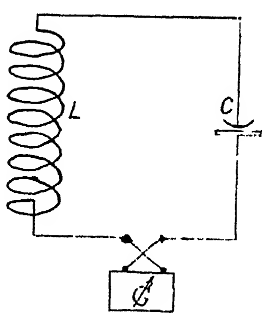


Figure 4



mum was applied. This shows that the capacity of the condenser varies inversely as the applied voltage as stated by Wente and Crandall in the Physical Review for July, 1917 and June, 1918.

When a continuous vocal tone was used instead of the alternating current, the galvanometer reading was also caused to drop off.

These tests showed that the resonance condition of the circuit could be changed by vibration of the condenser and that the amount

Figure 5.

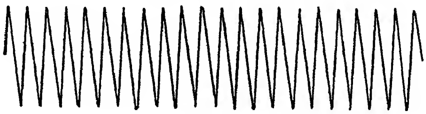


Figure 6.

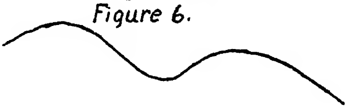


Figure 7.

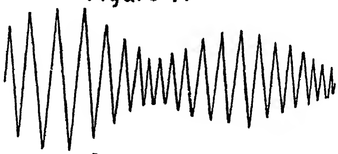


Figure 8

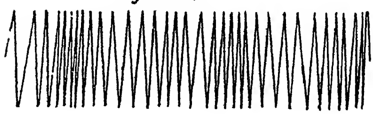


Figure 9.

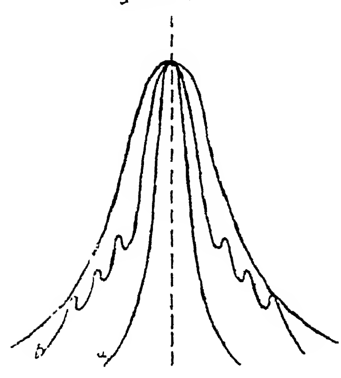
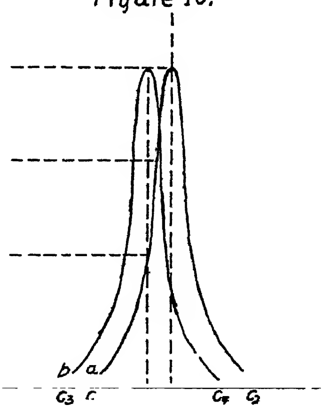


Figure 10.



of the change varied in proportion to the amplitude of the impressed voltage.

The receiving set was then connected with a vacuum tube as in Figure 3 and the vibratory condenser was replaced by a small variable condenser of approximately the same capacity.

The vibratory condenser was connected in series with a small transmitting condenser and the two placed in parallel with the condenser on the transmitting set. (See Figure 2). Energy was supplied to the vibrator as before.

The wave length of the transmitter was then measured by the Lecher wire method as outlined on page 170, experiment No. 102, of "Experimental Radio" by Ramsey. Resonance was found to be sharpest at about eight meters. The corresponding frequency is $\frac{300,000,000}{8}$ equals 37.5 x 10^6 oscillations per second.

The receiving set was then tuned to this wave-length, and it was found that the condenser acted as a modulator controlled by the voice.

In the ordinary type of modulation the amplitude of the oscillating current that flows in the oscillating circuit is directly controlled by the amplitude of the audio frequency current. Figure 5 shows the wave-form of an unmodulated oscillator, giving a current of constant amplitude and constant frequency. When an audio-wave, Figure 6, is impressed upon the microphone of the modulator circuit, the plate voltage of the oscillator tube is made to vary as the audio frequency varies. This causes the outgoing or transmitted wave, to vary likewise, and a wave of varying amplitude is obtained. Figure 7 shows the modulated transmitted wave.

This method of combining radio-frequency current with audio-frequency control of its amplitude yields resultant frequencies that are, together, about five kilocycles broad . Consequently, a receiving set that responds to all of the side-bands must be tuned somewhat broad. If curve a in Figure 9 represents the resonance curve of the unmodulated transmitter, curve b will be that of the modulated or transmitted wave resulting from the previously described beats-producing, or heterodyning effect of the modulation. If the receiving set is to respond to this broadcast wave, it must be tuned broadly enough to cover the field range, as shown by curve c.

In the type of modulation used in the experiments described by this paper, the amplitude of the current going into the oscillator remains constant. Modulation is obtained by variation of the capacity in the oscillating circuit. The capacity change results in a broadcast wave of variable frequency. The radio frequency changes in amount, depending upon the change of capacity of the vibrating condenser, which in turn, depends upon the amplitude of the audio-frequency vibration of the vibrating condenser. The audio-frequency

is represented in the final wave-train, merely, by the cyclically and periodically progressing system of alterations of the radio frequency, and not by any simple function of the frequency of the radio current existing at any particular time. Figures 5, 6, and 8 show this type of modulation.

If curve a of Figure 10 represents the resonance curve of the transmitter at constant frequency, it is seen that any change in frequency, caused by a capacity change, will produce a shift in the resonance curve, as shown by b. Thus, the current in a receiving set, tuned to resonance with the unmodulated transmitter wave, will vary as the transmitted frequency changes in response to the audio-frequency alteration of the capacity in the transmitter's circuit. I_m^2 is the resonance current at capacities C_1 and C_2. I_1^2 is the current in the receiver when the capacity of the transmitter has changed to C_3 and C_4. This illustrates how the current varies as the transmitted frequency is varied.

This makes possible very fine tuning of the receiving set, because the shift of the operating point on the resonance curve, due to this small change of radio-frequency that has been impressed by the amplitude of modulation, can be made to yield a large current change for extreely small radio frequency changes if the decrement of the receiving circuit is extremely small.

EARLY LIFE OF THE THIRTEEN-LINED GROUND SQUIRREL[1]

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In connection with a study of hibernation of the thirteen-lined ground squirrel, large numbers of the variety found in western Kansas, Citellus tridecemlineatus pallidus (Allen), have been procured each spring. Many of the females have been pregnant and have given birth to litters in the laboratory. In only a few cases have the animals bred in the laboratory (Johnson and Wade, 1931, Johnson and Foster, unpublished) although both sexes were present in nearly all of the cages. One case observed in 1926 was followed by the birth of a litter (Y3, Figs. 2, 9-12) between 27 and 28 days later, confirming the observation of Drips (1919) and O. Wade (1926) as to the length of the gestation period.

Various observations have been made for some years on the reproduction of these squirrels from the field and also on the sexual development of those in the laboratory. Series of pictures of some of the several litters conceived in the field but born in the laboratory were taken in 1925, but publication was postponed when three stages in C. t. tridecemlineatus were illustrated by O. Wade (1926). Since that time, however, more data have accumulated and special studies on the reproduction in the ground squirrel have been undertaken in this laboratory. It now seems desirable to make available this material on their early life.

The litters actually known to have been born in the animal house from mothers which had bred in nature in 1925 were born on April 29, May 4, May 5 (three litters), May 6 (two litters), May 7 (four litters), May 8, May 10, May 12 and May 13. In 1926 one was born April 21 and another May 13. One litter conceived in the laboratory on the day the parents were received was born May 22 (Y3, Figs. 2, 9-12). In 1927 litters were born May 7, May 9 and about May 12. In 1931 litters were born May 6, May 13 (four litters), May 14 (three litters), May 15 and May 16 (six litters). Two litters produced by animals which had been in the laboratory from the summer of 1930 were born February 28, 1931, and evidence of a pregnancy in a third laboratory female was found in the presence of corpora lutea in the ovaries on February 14, 1931 (Johnson and Foster, unpublished). There were indications that many other litters were born in the laboratory from females recently secured from nature, but only litters actually seen are included in the list given.

1. Contribution No. 141 from the Department of Zoology, Agricultural Experiment Station, Kansas State College of Agriculture and Applied Science.

In 1925 the majority of the litters were born May 5-7 and in 1931, May 13-16. The few litters born in 1926 and 1927 support the evidence of the other two years that the majority of litters are born shortly after the first of May to near the 20th of May in Kansas. In more northern states they may be born later in May (Johnson, 1917). The exact time doubtless depends upon the lateness of the spring and upon the weather. Ground squirrels are seen in great numbers on clear warm days in April in western Kansas. These periods of nice weather alternate with cloudy and stormy weatther, which probably accounts for the birth of most of the litters in a period of three or four days, and a few litters at scattered intervals before and after that period. Most of the females probably come into oestrus shortly before or during a particular period of warm weather and become impregnated while above ground at that period. Those not in oestrus at that time have probably bred at a previous or will breed at a succeeding period of good weather.

The number of young per litter were counted soon after birth in 20 litters in 1925, 1926, 1927 and 1931. As is shown in Table I, nine young was about the average per litter born. Very probably

TABLE I.

Litter Size in Ground Squirrels

Number in a litter:	4	5	6	7	8	9	10	11	12	13
Number of litters born having the number of young indicated at top of columns	0	0	6	0	3	5	3	2	0	1
Number of litters seen at autopsy or at operation	1	0	1	2	2	6	6	1	2	0
Total litters of size indicated at top of column	1	0	7	2	5	11	9	3	2	1

some of the litters with only six had been larger but some of the young had been eaten before they were counted. That about nine is the average is also indicated by the autopsy and operation observations of the number of embryos. Small resorbing embryos were not counted. Lee (1909) found the average number of embryos to be eight and one-half in 129 pregnant females of C. t. tridecemlineatus. Some indication was had that the number of young born is reduced from the number conceived somewhat in proportion to the ill health or malnutrition of the mother, for poor animals frequently had one to four embryos which were smaller than the rest and evidently were being resorbed.

After young were born it was not certain that they would be cared for. In many cases they disappeared one or more at a time.

This may be attributed in part to nervousness produced by the strange environment, but it must be said that when milk was fed the mother it appeared that the young were less likely to have a place in her diet. It should also be added that the young also grew better when

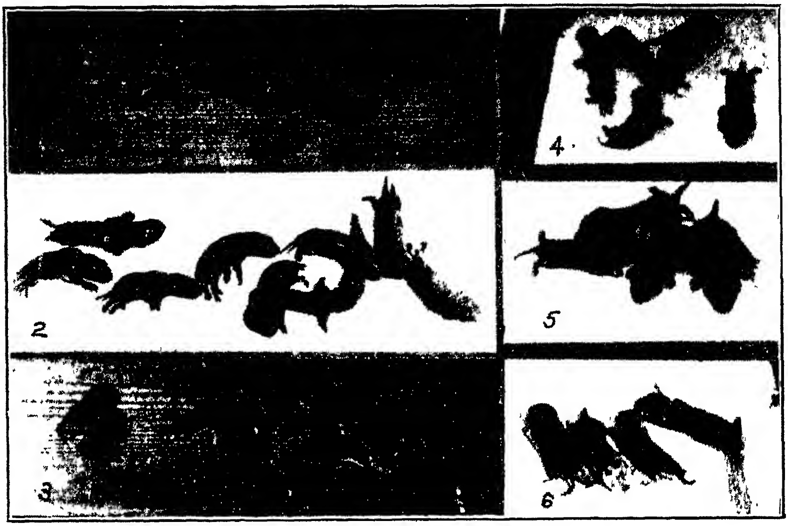

Fig. 1. Litter Y11, May 11, 1925. 0 days old. The one at the left had just been born. Note the wrinkled skin, slight bulge where the eye is, the short tail and hind legs.

Fig. 2. Litter Y3, May 22, 1926. Less than one day old. Note the features seen in Fig. 1, also the rolling over of some, and the movement of the fore legs producing a blur on the film in some cases.

Fig. 3. Litter Y8, May 11, 1925. Five young, at right, four days old. Litter Y6, four young at left, five days old. Note crawling positions, the developing eye and external ear.

Fig. 4. Litter Y12, May 18, 1925. Five days old. Note the same features as in Fig. 3. Figs. 4, 5 and 6 are reduced more than Figs. 1, 2 and 3.

Fig. 5. Litter Y8, May 18, 1925, 11 days old. Downy hair present but not seen in picture. Note increase in breadth and evidence of more power in locomotion. Faint indication of stripes present on head but not seen in picture. This litter was slower than most in the development of stripes.

Fig. 6. Litter Y6, May 22, 1925, 16 days old. Note stripes, lack of contrast of the stripes on the back and the beginning of contrast on the head of one where a light yellow is becoming evident.

milk was available as early as they could drink it and until they had attained nearly adult size in the fall. It is not unlikely that the diet on which rats and mice grow exceedingly well is not rich enough in protein for ground squirrel mothers and young. It was found in 1931 that the young ground squirrels were very eager for the flesh of rats which were fed them after the rats had been killed for pituitary implant work.

The Young at Birth

At birth the ground squirrels were found to resemble embryos in the absence of hair and in the lack of development particularly of the hind legs and eyes (Figs. 1 and 2). The skin was red to pink, and wrinkled. The eyes were not open but their position was indicated by a slight rounded protrusion on the sides of the head. Shortly after birth the eye could be seen as a blue structure underneath the skin. A small ridge also indicated the future external ear. The forelegs were capable of a little movement and helped to keep the dorsal side up part of the time, although the animals rolled about considerably when removed from the nest. The sutures between the two parietal bones and between those and the occipital were evidenced by a wide band in which no ossification had taken place. The body was translucent and some of the internal organs could be seen through it.

The weight at birth was found to be 2.0 gm. in each of five young just born. They belonged to three different litters. As young apparently obtained milk from the mother shortly after birth and as in two cases they were born as much as an hour apart it is evident that the weight of an ordinary litter after all were born would be greater than the sum of the weights at birth. For instance the one to the left in litter Y11 (Fig. 1) weighed 2.0 gm. immediately after birth, but the other three born earlier averaged 3.3 gms. each when weighed. Nine litters (67 animals) known to be less than 24 hours old and therefore averaging about 12 hours old, showed an average weight of 3.2 gm. per animal. The lightest litter averaged 2.8 gms. and the heaviest, 3.5 gms. per animal. From the data at hand it would appear that the weight at birth, in this variety, may range from about 2.0 gms. to about 3.0 gms.

Development in Form After Birth

The general changes in appearance after birth may be seen in the illustrations. By three days of age the young animals showed much greater strength and activity when handled. They used the fore legs considerably more than the hind legs in crawling on one's hand or on a cloth. They also uttered squeaks when handled as well as when the mother touched them in the nest. In some the sutures on the head were still plainly visible through the pink skin but in others the skin was becoming darker (reddish gray) and the sutures

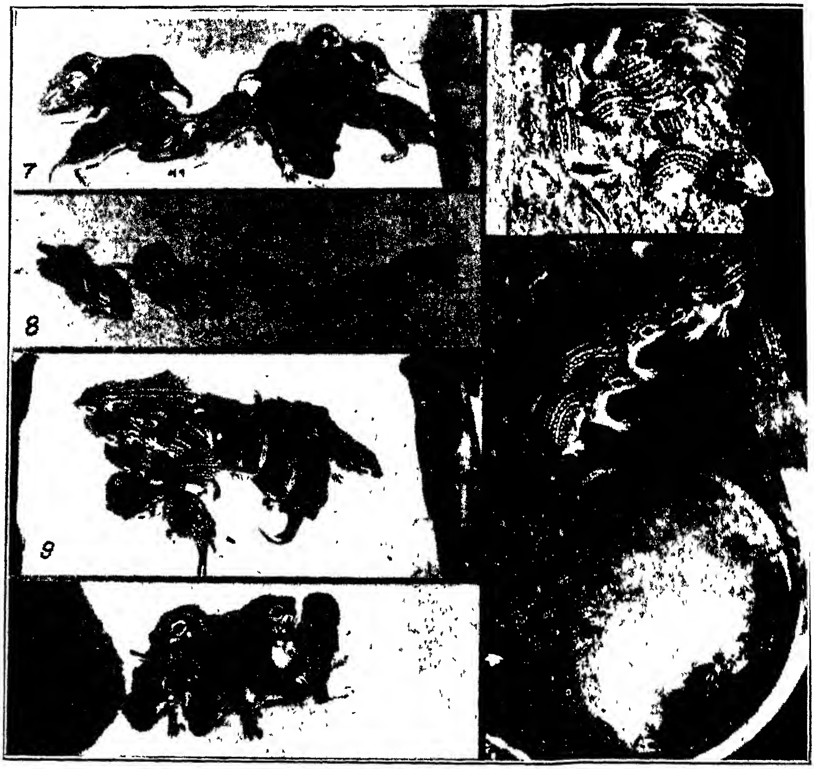

Fig. 7. Litter Y8, May 26, 1925, five young at right, 19 days. Litter Y6, four young at left, 20 days. Note lighter pigmentation of the Y6 group. The Y8 young were not as well nourished and were slower to assume the lighter or adult coloration.

Fig. 8. Litter Y6, May 29, 1925, 23 days. The eyes are open in one animal.

Fig. 9. Litter Y3, June 16, 1926, between 25 and ... ld. A vigorous litter, the same as in Fig. 2. The eyes ar...

Fig. 10. Litter Y8, June 9, 33 days old. Note th... on sides and the darker appearance of the thin ai... The animals were held under the hands until they beca... the hands were removed and the picture taken.

Fig. 11. Litter Y3, June 23, 1926, 32-33 days old. No... hairs on sides of body and tail. The animals could no... trusted to remain in a shallow container.

Fig. 12. Litter Y3, June 30, 39-40 days old. The body has been increasing in size in comparison with the head and feet.

Fig. 13. Litter Y3, July 13, 52-53 days old. Note further increase in body size. Picture taken in a lard can to prevent escape. This figure is reduced more than the other.

could not be seen so clearly. The ear was a small elevation with a shallow vertical depression in the middle. The skin covering the eye also showed a slight depression where the eyelids would later separate. Short hairs (vibrissae) had made their appearance around the mouth.

Nearly all the structures mentioned showed slight changes each day, but these were not uniform in the various litters. Pigmentation deepened (Figs. 3 and 4) to a dark gray with a reddish cast on the dorsal surface, the eye and ear grooves became more distinct, the vibrissae became longer and the hind legs tended to spread out some and to help in crawling and in keeping the animal from rolling over as it crawled. Some young would jump and throw the body from side to side when handled. In a number these changes were apparent on the fourth day, in others a day or two later. The skin was still wrinkled.

By the age of six or seven days very short and very fine hair was seen on top of the head and back. Pigmentation of the skin prevented the sutures in the head from being seen. The animals showed greater activity in jerking about and crawling. The hind legs sometimes dragged behind, sometimes assisted the forelegs in crawling (Fig. 4). The head was still large in proportion and the nose bobbed up and down or slid along the table as the animal crawled. The eyelids and ears showed slight development. The pigmentation was slightly greater.

By eight days of age the first indication of stripes in the skin dorsally on the head, neck and shoulders and on the sides was seen in an occasional individual, and by ten days nearly all showed at least faint stripes on the head and shoulders. The middle of the back was so darkly pigmented that the stripes appeared there very faintly a day or two later than anteriorly and laterally. The stripes changed slowly and in a few small thin individuals were scarcely evident even at 12 days of age. The bases of the nails also showed a beginning of pig[illegible] at about the time the stripes first began to appear. [illegible] from abou[illegible] the back could be seen when the animal was held

The [illegible] ability to crawl was seen from day to day. At the ill[illegible] or eleven days of age they could progress fairly well on much [illegible] but they did not usually raise the body from the table for[illegible] metimes, however, even for a few days more, they would [illegible] hind legs drag while they took a few steps with the fore legs.

At about 15 to 20 days of age (Fig. 6) the weak squeaks they had been uttering before this when handled changed to a semi-whistle, more piercing than before but not yet like the whistle of the adult,

lacking especially the tremolo of the latter. This was observed somewhat later than 12 days, the time at which Wade (1927) found the "thrill" of the adult present in his C. t. tridecemlineatus. The difference may be due in part to individual variation rather than to a varietal difference. While raising the body more and more during this period the young still spread the legs some and even rolled over sometimes when 20 days old. The upper incisors were seen to be just emerging and the lower ones were well through the gum. The nose still rested on the table but was raised in walking. The ears had been extending for some days. At 21 days of age the stripes began to lose some of the dark grayish color and to assume something of the yellow and brown of the stripes of the adult.

Assumption of Adult Appearance and Independence

The color and whistle of the adult were both attained approximately at 23 days in many of the young (Fig. 8). The eyes also began to open about this time in the better developed individuals. In the five litters observed from day to day in 1931 practically all of the eyes opened at 24 to 27 days. (Table II). Some of the animals in poor

TABLE II

Ages at Which the Eyes of Young Ground Squirrels Opened

The numbers in the table show the number of eyes opened the day given at the top of the columns

	Condition of young	Age in days 23	24	25	26	27	28	29	30
Group 1	Good	2	8	6	2	2	0	0	0
Group 2	Poor	0	0	0	0	3	0	1	4
Group 3	Good	0	4	0	2	0	0	0	0
Group 4	Good (most)	0	0	0	2	1	8	0	0
Group 5	Fairly good	0	2	6	4	10	0	0	0
Totals		2	14	12	10	16	8	1	4

condition did not open their eyes till they were 28 to 30 days of age, however. Wade (1927) found the time of opening of the eyes in one litter of C. t. tridecemlineatus to be 26-28 days. Between 25 days (Fig. 9) and 30 days of age the young developed increased powers of locomotion and could run rapidly, though somewhat awkwardly, on the table but only a few tried to any great extent to avoid capture at this age. At about 30 days of age a few long white hairs extended out beyond the other hair giving the animals a rough or "fuzzy" appearance for several days (Figs. 10 and 11), some of these hairs still being evident at 39 days of age (Fig. 12).

The weaning time appeared to vary with the different mothers. Wade (1927) considered it to be at about 29 days in his litter. By

reference to the growth curve (Fig. 14) a stopping of growth is evident at 26-28 days and at 31 days of age. There is no reason for this other than failure to get enough milk for their needs from the mother. By 30 days of age some at least had begun eating ground feed and drinking the milk in the cages. Attention to placing the feed where they could get it readily and probably their increasing ability to assimilate it resulted in a more rapid rate of growth than before weaning (Fig. 14).

In this respect the growth curve agrees with those of prairie dogs (Johnson, 1927) and rats (Johnson and Sayles, 1929). During the first year that young ground squirrels were raised it was observed that after about a month at which time the weaning process was

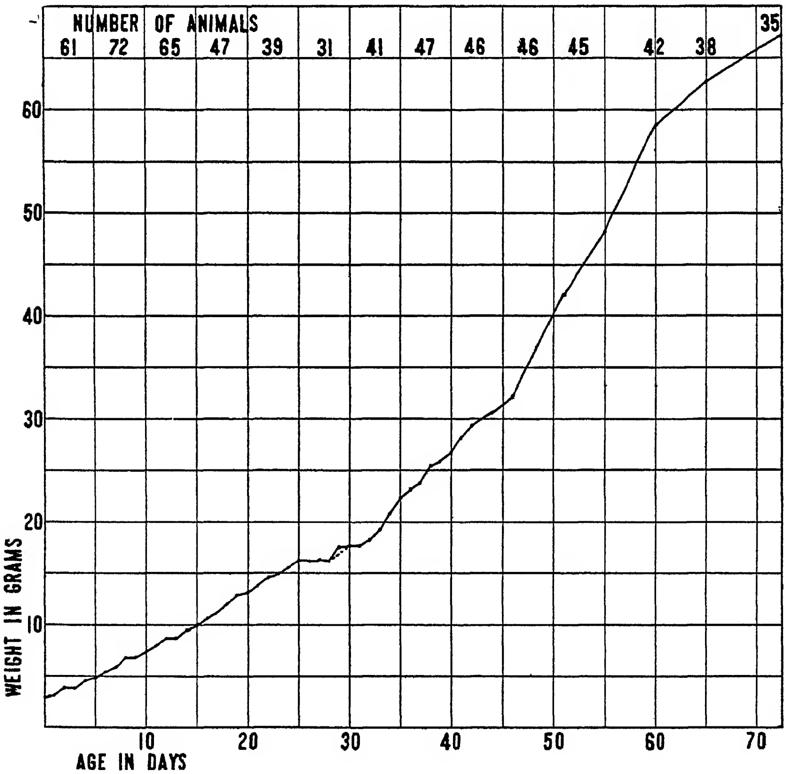

Fig. 14. Graph showing growth curves of young ground squirrels. The number of young given at the top are averages for each five days as long as daily weights are shown in the graphs. On the 29th day the animals were weighed two hours later than usual, which was after feeding.

under way many of the young tended to become thin and die. Recognition of this as a very critical age and a consequent addition of cow's milk to a balanced ration, including cod liver oil, resulted in a reduced death loss during the second and later years. Observations indicate that weaning may begin as early as the time of opening of the eyes (about 24 to 27 days of age) to some days later, and may not be complete for several days.

At about the age of 34 days it was noticed that some of the young avoided capture in the cages, but only feebly when once caught and placed on a table. A quarrelsome disposition became evident at this age in a few but those handled did not usually try to bite. Other young, not weighed and therefore not accustomed to being handled, more frequently tried to bite.

Sexual development was proceeding for some of the males "rode" the females when 34 days old and later. Two thin males had medium small testes descended into a small dark scrotum at 72 days of age Of others which were medium fat to fat, six had medium sized testes in a small unpigmented scrotum, two more were slightly scrotal, but four showed no sexual development.

Summary

Observations on changes in form and weight of young ground squirrels are reported and illustrated. The young were embryonic (pink, hairless and eyeless) and weighed from 2.0 gm. to about 3.0 gm. at birth. The back soon became very darkly pigmented. Fine hair appeared at six days and a slight indication of stripes at eight days in some. Between 15 and 20 days of age their squeaks changed to a semi-whistle, the hind legs began to be used in a sprawling walk, and the incisor teeth appeared. The adult color of the hair, and the adult whistle were attained by the time the eyes opened, which took place at 24-27 days of age in most of the young. The development of speed and balance in locomotion, the ability to consume dry feed, and weaning came in the first few days following the opening of the eyes.

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THE VALUE OF GUIDANCE IN READING FOR INFORMATION

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This study is an experimental investigation of the value of guidance in learning by means of a new automatic self-checking device, the Self-Instructor and Tester[1].

In its simplest form this device consists of one or more sheets of multiple-choice questions whose correct and incorrect answers are treated with two matched moisture-sensitive inks which turn to contrasting colors when moistened. In using this device the learner reads each question, chooses from its alternative answers the one he deems correct and touches it with a strip of moistened felt. If the chosen answer is correct, it changes immediately to a predetermined color, say blue; if incorrect, it changes to a different predetermined color, say red. This change of color simultaneously records his response and shows the learner whether his choice of answers was correct or incorrect.

Obviously this device can be used both as a means of guidance in learning and as a means of improving speed and accuracy in scoring tests of what has already been learned. When used for guidance questions are made more minute and searching and the learner is permitted, after reading a question, to make the necessary calculations and investigations—which may include the reading of reference or text material—before choosing and recording his answer. This was the manner in which the device was used in the present study.

The reading matter here used consisted of Chapter VI and a portion of Chapter VIII of Woodworth's Psychology (Revised). This reading matter was divided into three separate assignments as follows: (1) Assignment A comprising the first half of Chapter VI accompanied by 42 appropriate questions, (2) Assignment B comprising the remaining half of Chapter VI accompanied by 42 questions and Assignment C comprising the first 21 pages of Chapter VIII accompanied by 25 questions.

In Assignments A and B the subjects were all members of two sections of a class in introductory psychology, who were at liberty for two consecutive hours between 1:00 and 5:00 o'clock on certain afternoons in November 1930. In Assignment C the subjects were all those

1. Devised by H. J. Peterson and J. C. Peterson and previously described by the latter as "A New Device for Use in Teaching, Testing and Research in Learning" in the Transactions of the Kansas Academy of Science, Vol. 33, 1930, pp. 41-47. (A patent on the device is pending.)

who took part in previous assignments and were present at a given class period later.

The subjects were divided into an experimental and a control group of equal ability as rated by previous tests in psychology. In Assignment B the experimental and control groups of the previous assignment exchanged places so that the controls of the first assignment became the experimental subjects of the second and vice versa. Though the parity of the groups was slightly disturbed by the absence of some subjects no subsequent eliminations were made to restore exact equality because of the small numbers of subjects included. That the disparity was not serious in any case will be seen in the record which follows.

Before the commencement of study on Assignment A, and likewise on Assignment B, its accompanying list of multiple-choice questions was taken by all subjects as a preliminary test. After leisurly completing this test each subject exchanged it for another copy of the same list of questions which he then proceeded to answer to the best of his ability with the aid of his text book. Students were encouraged to read with care and to re-read as often as necessary. With the understanding that quality alone would determine the score each student recorded the time of starting and that of finishing the assignment to the nearest five seconds by reference to a large laboratory clock. As soon as he had finished the assignment each student exchanged his question sheet for a third copy of the same test which as in the preliminary test he now answered without reference to his text book or his notes.

The assignments given to paired experimental and control groups were identical in all respects except that the second test sheet (study sheet) of the experimental subjects was treated chemically as described above and answers were recorded by means of a chemopen[1] instead of the ordinary pen or pencil used by the control subjects. The subjects were encouraged to do their best in all tests and just preceding the second and third test on each assignment were informed that scores in these tests would count in the determination of their semester grades.

In the presentation of results the following abbreviated terms are used as defined below:

M: the arithmeic mean.
E: the control group.

1. The chemopen is a strip of absorbent material (here felt) moistened with water or, when needed, a chemical in solution and inclosed for convenience in a water tight tube.

C: the experimental group.
I: the prelinminary test.
II. the same test answered during study with the aid of text.
III: the same test repeated immediately after study without reference to the text.

Table I. Scores Attained in Assignment A[2].

	Group E (experimental, N=23)		Group C (control N=20)	
Test	M	sM	M	sM
I	27.00	.63 $r_{i\,iii}=.39$	20.85	.93 $r_{i\,iii}=.69$
II	33.00		30.25	
III	37.61	.90	30.40	.90

Disregarding for the present the scores attained in Test II during study with the text, let us observe the gains made by Group E and Group C in Test III as compared with Test I. Group E gained 10.61 points and Group C gained 3.55 points. Those who used the self-checking device thus gained three times as much on the average as those who used only the test questions for guidance in reading. The difference in gains is 7.06 points in favor of the experimental group and the standard error of this difference is 1.21 points. The difference in the gains of Group E and Group C is therefore 5.83 times as large as its own standard error in favor of the experimental group.

In Assignment B, as previously stated, the groups exchanged places so that the experimental group of Assignment A became the control group of Assignment B and vice versa. The results of this experiment are listed below in Table II.

Table II. Scores Attained in Assignment B.

	Group E (N=20)		Group C(N=22)	
Test	M	sM	M	sM
I	27.18	.62 $r_{i\,iii}=.30$	26.95	.72 $r_{i\,iii}=.68$
II				
III	37.91	.82	31.41	1.00

In this assignment Group E gained 10.73 points as compared with a gain of 4.46 points for Group C in passing from Test I to III. Here then the group who gained only one-third as much as their competitors through study of Assignment A, gained 2.4 as much as those same competitors through study of Assignment B. This marked shift in gains always in favor of the group who used the self-checking device when other factors were constant must apparently be attributed to the influence of the device on learning. The difference between the gains of the experimental group and the control group is here 6.27 points and the standard error of the difference is 1.16

points. (The reliability of the difference between gains in here calculated by means of the formula:

$$sDg\sqrt{s_1^2+s_2^2+s_3^2+s_4^2-2r_{12}s_1s_2-2r_{34}s_3s_4}$$

from Lindquist, E. F., and Foster, R. R., Journal of Educational Psychology, Vol. 20, 1929, p. 105.) This difference in gains is therefore 5.40 times its own standard error.

Fortunately similar comparisons can be made between the performances of each group with and without the use of the tester because Assignment A and B were found to be almost exactly equal in difficulty. In the preliminary tests on these assignments the mean score of the smaller group was one-third of a point higher in B than in A while the mean score of the larger group was one-twentieth of a point lower in B than in A. Comparing the two mean scores of the larger group on these preliminary tests, we find an advantage of 6.71 points in the test with which the self-checking device was used. The standard error of this difference is 1.48 points. The difference is therefore 4.53 times its own standard error. Comparing the two mean scores of the smaller group on the preliminary tests, we find an advantage of 6.05 points in the test with which the self-checking device was used. The standard error of this difference is therefore 4.91 times as large as its own standard error.

Notwithstanding the smallness of our groups all of the four comparisons of performance listed above favor the group using the tester device or the test with which the device was used. And each group and each test was in its turn so favored. The smallest of these four differences is four and a half times as large as its own standard error. This gives a fairly strong presumption of genuine and probably large value in the use of the device as a guide in reading for information. But the fact that the final test was a mere repitition of the preliminary and study tests may raise a question concerning the flexibility and applicability of knowledge gained by its use. A par tial test of this point was made in Assignment C.

The purpose of Assignment C was to test the flexibility of knowledge gained as a result of using the tester device. The final test here was accordingly formulated in new terms and the majority of its questions stated in completion-test form. To introduce still further variation its questions were presented orally. The preliminary test was omitted and the study test, reduced to 30 minutes duration. To motivate the home preparations students were told two days prior to the test when the assignment was announced, that there would be an objective test before class discussion. Here, as in Assignment A and B, students were allowed to use their texts while taking the study test but not during the final test.

2. Throughout this paper the letter "s" is substituted for the Greek letter sigma.

The results of this experiment are presented in table III below.

Table III. Scores Attained in Assignment C.

	Group E (N=17)			Group C (N=19)		
Test	M	sM		M	sM	
II (Study Test)	17.53	.85	$r_{ii\ iii}=.90$	19.05	.51	$r_{ii\ iii}=.71$
III (Final Test)	20.59	1.17		18.84	.75	

Apparently the difference in the mean scores of Group E and Group C in Test II results from the fact that more members of the former than of the latter group failed to finish the test before time was called. Thirty-three questions remained unanswered on the test sheets of six subjects in Group E whereas all members of Group C finished except one who omitted five questions[1]. The gains from

Test II to Test III were +3.06 for the experimental group and -.21 for the control group. The difference in these gains is 3.27 in favor of the experimental group and the stanaard error of this difference is .762. The difference is therefore 4.30 times as large as its own standard error.

Here again the difference in gains in favor of the subjects who used the tester device is statistically significant. Moreover despite the limitations in time which hampered the experimental group more seriously than the control group, the difference is almost as significant here as in the preceding assignments. Apparently the flexibility of knowledge or its availability for use in the solution of new problems is not adversely affected by the use of our tester device in its acquisition.

The value of the Self-Instructor and Tester is, moreover, not limited to the self-checking feature which alone accounts for the facilitation of learning found in the foregoing experiments. The entire device also comprises numerous objective questions which serve to direct the attention of the learner and motivates his efforts. The value of such questions is roughly indicated by the findings of Washburne who reported that "a genuine difference in learning amounting in the case of experimental generalizations to 40 per cent of the mean score or over 5 P. E. diff. is involved in the use of questions". (1) In a study of learning which involved 10 repetitions Symonds and Chase likewise find objective tests of considerable value. "The value of test motivation", they conclude, "may be estimated as the equivalent of about five sheer repetitions". (2).

1. In assignment A an average of 64 minutes was required by the experimental subjects and 63.8 minutes by the controls. In assignment B an average of 62.4 minutes was requ'red by the experimental group and 60.9 by the controls.

In conclusion it may be said that of the five comparisons here made between performance with and performance without the self-checking feature of the Self-Instructor and Tester, all comparisons showed statistically valid differences in favor of performance with the self-checking feature. On the average the groups who used this feature of the device in reading gained from 2.4 to 3 times as much in information as did those who used only the questions as a guide. Gains were practically as great when study-test questions were re-worded and changed to completion form as when the same miltiple-choice questions were given both in the study test and in the final test. Almost invariably students express a strong preference for the entire device, including the self-checking feature, as compared with the mere list of objective questions.

1. Washburne, John N. "The Use of Questions in Social Science Material". Journal of Educattional Psychology, Vol. 20, 1929, p. 355.

2. Percival Symond and Doris Harter Chase, "Practice vs. Motivation". Journal of Educational Psychology, Vol. 20, 1929, p. 31.

THE ACTION OF BROMINE AND IODINE MONOCHLORIDE ON SOME SCHIFF'S BASES

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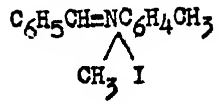
Schiff's bases are the condensation products of aromatic aldehydes and amines; for instance benzal aniline, $C_6H_5CH{:}N\text{-}C_6H_5$ is a typical example. In such a compound the points of attack would be (a) the double bonding N=C, and (b) the two benzene rings, the one attached to nitrogen being the more reactive.

A number of investigators have studied the action of bromine upon such compounds, and their results are briefly indicated as follows:

Schiff[1] first tried bromination of bases from the unsaturated cinnamic aldehyde and amines such as aniline. He found that his brominated base contained two atoms of bromine, and concluded that they must have added at the carbon-carbon double bond of the aldehyde. Subsequent hydrolysis of this product, however, yielded cinnamic aldehyde and para-brom-aniline.

Franzen and Eidis[2] suggested that the bromine might add at the carbon-nitrogen double bond, but the hydrolysis products of the Schiff's bases made this view improbable.

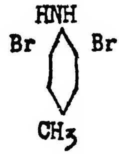
Hantzsch and Schwab[3] treated benzal para-toluidine with methyl iodide and concluded that the reaction gave the addition product,



They assumed also that bromine would add to the amine nitrogen and then rearrange, entering the ring, an hypothesis which would account for the instability of the dibromide and its ease of hydrolysis.

Berg[4] found that the bromine content of brominated bases was not constant for several runs of the same base. He also favored the pentavalent nitrogen theory.

Dains, Wainscott[5] and Blue[6] treated a number of Schiff's bases with two moles of bromine with the idea of determining the mechanism of reaction and the resultant products. For example, the brominated benzal para-toluidine, $C_6H_5CH{=}NC_6H_4CH_3$, when hydrolyzed yielded benzaldehyde and 2-6-dibrom para-toluidine



They also concluded that the bromine added to the nitrogen and then rearranged into the amine ring. They found that the benzal group was never attacked, but that the salicylal group was easily substituted due to the influence of the phenolic group. The amine was brominated as usual without reference to the nature of the aldehyde.

In the following investigation the action of one or of two moles of bromine on substituted Schiff's bases was studied; the substituting groups chosen were hydroxyl or methoxy in order to ascertain their effect on the ease and position of substitution of the bromine. Following this is a report of the action of iodine monochloride upon such Schiff's bases.

Preparation:

Schiff's bases may be prepared by adding the aldehyde to the amine and heating on the water or oil bath, or by dissolving each in a common solvent and mixing the solutions. It was found that the latter method was in general preferable since the bases, if solids, precipitate in such purity that recrystallization often is unnecessary.

Method of Substitution

Halogenation was carried out by dissolving 10 to 15 grams of the base and the desired amount of halogen in about 300 cc. and 50 cc. of carbon tetrachloride, respectively, and slowly adding the latter solution to the former with turbination. For those bases insoluble in carbon tetrachloride, chloroform or glacial acetic acid was used. The products, which precipitated at once, were almost always non-crystalline, except where ice baths were used about the reaction flask, and seemed to be mixtures of the salts of substituted bases.

Identification of Products

In order to find out which ring was attacked by the halogen, the halogenated bases were hydrolyzed and the products studied. At first hydrolysis was effected by refluxing 10 to 15 grams of the halogenated base with 100 cc. of 10 to 15% hydrochloric acid. This mixture was steam distilled until the distillate was clear, then made alkaline with sodium hydroxide solution and further distilled. The products coming over, as well as the residual material, were purified and examined. It was later found that hydrolysis was often possible

with little or no acid simply by blowing steam through the solution. The use of dry sodium carbonate in neutralization reduced the volume of solutions and lessened the amount of tar.

Analysis

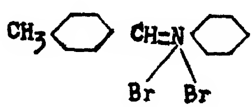
The halogenated bases were dissolved in dilute alcohol and titrated with standard sodium hydroxide solution. Due to the yellow or brownish solutions, phenolphthalein was used as indicator. This gave the halogen acid content of the salt. The bases, and some of the hydrolysis products, were analyzed for total halogen by combustion in the Parr bomb and titration with silver nitrate solution by the Volhard method.

Experimental

Action of Bromine:

1. Anisal aniline, $CH_3OC_6H_4CH{=}NC_6H_5$, in carbon tetrachloride when treated with one mole of bromine in the same solvent, yielded a light yellow, non-crystalline product, which decomposed at 183-184°. Analysis showed 27.67% HBr and 51.83% Br. On hydrolysis there was obtained anisaldehyde, 2-4-6-tribromaniline and 4-bromaniline. The last two were identified by mixed melting-points.

Treatment of the base with two moles of bromine gave an orange-yellow product decomposing at 155-157°, which contained 29.39% HBr and 55.57% Br. On hydrolysis anisaldehyde, 2-4-6-tribromanaline and 4-bromaniline again were obtained. The amounts of HBr and Br found were higher than expected. This, with the variety of bromated amines, leads to the conclusion that the original brominated base was a mixture of the HBr salt of the base, with possibly the bromine addition product—



2. Anisal anisidine, $CH_3C_6H_4CH{=}NC_6H_4OHC_3$, gave with one mole of bromine in chloroform a yellow, crystalline precipitate which decomposed at 190-192°, and which contained 34.61% HBr and 48.85% Br. On hydrolysis anisaldehyde was isolated, leaving a purplish solution in the distillation flash, but no solid. This occurred in other experiments involving anisidine, including the attempt to brominate anisidine alone.

Treatment with two moles of bromine yielded a dark-yellow, amorphous material decomposing at 186-187° in which was found 36.23% HBr and 50.18% Br. On hydrolysis this yielded anisaldehyde and a residual purplish solution from which nothing definite could be isolated.

3. In order to study the influence of the hydroxyl and methoxy groups on substitution, salicylal para-anisidine, $HOC_6H_4CH{=}NC_6H_4$-OCH_3, was chosen. When treated in carbon tetrachloride with one mole of bromine, it deposited a yellowish product which shrank at 85-90° and finally decomposed at 120°. Found 22.12% HBr and 43.19% Br. On hydrolysis a little salicylaldehyde was obtained along with some light solid, which was recrystalized from alcohol and found to melt at 101°. It contained 41.91% bromine, while 5-brom-salicylaldehyde[7] melts at 104-105° and contains 39.76% Br. A second portion melted at 84-85° and contains 57.14% Br. Evaporation of the liquid left after hydrolysis yielded crystals which a mixed melting point proved to be para-anisidine. As before, a purplish solution was left, but no bromiated amine was isolated.

Treatment with two moles of bromine gave a dark yellow substance, which began to decompose at 85° and which had a bromine content of 49.38%. On hydrolysis there was isolated 5-bromo and 3-5-dibromo salicylaldehyde and also some of the crystalline dibrominated Schiff's base[5].

These results indicate that the free hydroxyl group of the aldehyde aids in substitution into the ring, while the methoxy group of the anisidine does not. Blue[6] also found that the ortho-hydroxy aldehyde was similarly attacked.

4. It seemed worthwhile to determine the effect on substitution of a hydroxyl group in the para position.

Para-hydroxy-benzal aniline, $HOC_6H_4CH{=}NC_6H_5$, in glacial acetic acid was treated with one mole of bromine in the same solvent. The light yellow product decomposed at 213°. Found 24.21% HBr and 35.26% Br. From the filtered solvent was obtained on dilution with water, a solid which was proved by mixed melting-point to be 2-4-6-tribromaniline. Hydrolysis of the brominated base also yielded 2-4-6-tribromaniline. A little oil was obtained whose acetyl derivative melted at 162-164°, and which proved to be p-bromo-acetanilide.

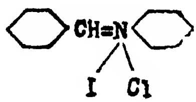
The base with two moles of bromine gave a yellowish non-crystalline precipitate decomposing at 205-210°. Found 25.65% HBr and

44.77% Br. Hydrolysis yielded 2-4-6-tribromaniline and a substance melting at 183-184°, which was identified as 3-5-dibrom-4-oxybenzaldehyde[9].

Action of Iodine Monochloride

Iodine monochloride, ICl, in general substitutes iodine into the ring with the loss of hydrogen chloride.

5. Benzal aniline, $C_6H_5CH{=}NC_6H_5$, in carbon tetrachloride, when treated with one mole of iodine monochloride, gave a yellowish-brown substance melting at 182°. Titration for hydrogen chloride gave high results which would seem to be due to the HCl or ICl addition products of the simple amine or of the free base, as for example:



Hydrolysis produced benzaldehyde and some crystals melting at 64° with acetyl derivative melting at 180°. Para-iodo-aniline[10] melts at 66-68° with acetyl derivative melting at 181.5°.

Addition of two moles of iodine monochloride gave a brownish substance decomposing at 190-192°, the hydrolysis products of which were benzaldehyde and para-iodo-aniline, but no di-iodo-aniline.

This agrees with the work of Blue[6] who found that bromine never attacked the benzaldehyde ring.

6. Benzal para-toluidine, $C_6H_5CH{=}NC_6H_4CH_3$, in carbon tetrachloride with one mole of iodine monochloride in the same solvent, yielded a brownish-yellow solid decomposing from 185°. The products of hydrolysis were benzaldehyde and 2-4-di-iodo-para-toluidine[14] melting at 126° (acetyl derivative m. p. 229°). A little oily material not positively identified seemed to be para-toluidine.

Treatment with two moles of iodine monochloride gave a yellowish-brown solid decomposing at 168-190°. On hydrolysis this gave benzaldehyde, 2-6-di-iodo-para-toluidine, and some 2-iodo-para-toluidine. These last two were identified by mixed melting-points and acetyl derivatives.

7. Salicylal para-toluidine, $HOC_6H_4CH{=}NC_6H_4CH_3$, in carbon tetrachloride solution with one or two moles of ICl gave solid residues melting with decomposition at 126° to 134°.

On hydrolysis the following products were isolated and identified; salicylaldehyde, 5-iodo-salicylaldehyde and to 2-iodo-p toluidine, thus showing that both rings were attacked.

Summary

The halogenated bases are usually non-crystalline and vary in different runs of the same one in stability, color and composition.

In most cases the halogen acid and total halogen content is higher than expected, due, no doubt, to addition of bromine or iodine monochloride to the nitrogen without rearrangement. Also hydrochloride salts of the free base or the amine would bring the halogen content high.

The addition of the second mole of halogen increases the proportionate yield of di- and tri- halides.

Iodine monochloride works well as an iodinating agent, but leaves free iodine in the product.

Benzaldehyde is not attacked. The hydroxyl group on the aldehyde favors substitution, particularly if in the ortho position, while the methoxy group on the aldehydes and amines has no favoring effect on substitution.

This study supports the pentavalent nitrogen theory. The halogens add to the nitrogen rearranging later to the amine ring, provided groups already permit. Halogenation of the aldehyde appears to be direct and independent.

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THEORIES OF LIESEGANG'S RINGS

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Many theories have been proposed by students of the so-called Liesegang phenomenon. Most of these are based on insufficient data and are inadequate. We propose to examine only two at this time.

In 1925 Wo. Ostwald proposed a theory that he called the Diffusion Wave Theory[11]. He considered that rhythmic precipitation in gels is due to three diffusion waves. The first of these that of the entering electrolyte; second, the diffusion wave of the internal reactant, while the third is that of the soluble product of the reaction. Ostwald claimed that most of the cases of rhythmic precipitation result in the establishment of equilibria between the reacting substances and their products. Because of this the precipitate will vary in amount in different areas, depending on the concentration at that time of the different substances in the reaction zone.

To illustrate his theory he made use of the reaction which occurs when a gelatin gel, impregnated with magnesium chloride, is covered with a strong solution of ammonium hydroxide. As the latter diffuses into the gel it reacts with the internal reactant and produces a white precipitate of magnesium hydroxide and a solution of ammonium chloride.

$$MgCl_2+2NH_4OH=Mg(OH)_2+2NH_4Cl.$$

Three of these substances are in solution. There are, therefore, three diffusions to be distinguished. The crest of the wave of the entering electrolyte is at the top since it has its source there. For the internal reactant the concentration is at its lowest in the reaction zone, and the rate of diffusion is highest just in front. The ammonium chloride has its highest concentration in the reaction zone where it is produced. Ostwald supposes that it diffuses from that region with equal velocity in both directions. But this can hardly be the case. The region towards the top has a high concentration of ammonium-ions since the reaction already has taken place there and the gel is filled with the products of the reaction as well as migrating ammonium hydroxide. The main diffusion stream is therefore directed toward the interior of the tube. The presence of a strong electrolyte ammonium chloride is ionized to the extent of 74%, according to Norris[10], in .1 N solution) prevents the ionization of the weak electrolyte, ammonium hydroxide, and so the amount of precipitate formed decreases until the upper limit of solubility of magnesium hydroxide is reached.

Since all the substances concerned are electrolytes, it will be well to write all reactions as ionic: $NH_4OH = NH_4^+ + OH^-$.

NH_4OH is a weak electrolyte, ionized only to the extent of 0.3% in normal solution. At equilibrium we may write

$$(NH_4)+ \times (OH)- = K.$$

It is quite apparent that any increase in the concentration of the ammonium ion will result in a decrease in the concentration of the hydroxyl ion from the formation of undissociated ammonium hydroxide. This condition will be found in the zone in front of the reaction area, since the ammonium ion is there in its greatest concentraton.

The reaction of the magnesium ion with the hydroxyl ion tends to reduce the concentration of the latter through the formation of a very insoluble product, and this counteracts the inhibiting action of ammonium ions and permits the formation of more hydroxyl ions. Since the magnesium ions are so largely removed from the reaction zone there will be a wave of diffusion of these ions toward that region, and most of them will reach the front of that area before they meet with enough hydroxyl ions to form a precipitate. After the reaction has ceased, the concentration of the ammonium ion falls rapidly, owing to dispersion, according to Pringsheim's rule[6]. As it decreases the concentration of the hydroxyl ion increases and precipitation begins again.

It is quite obvious then that the initial concentration of the reacting substances will regulate the extent of the ionization and the rate of diffusion in a given gel. Because of this, the thickness of the discs of precipitate and the distances between them will be regulated. This theory makes it quite clear that the nature of the gel will have a decided effect on the character of the precipitate, since its concentration will determine the size of the pores, and its composition the adsorptive power. By adsorption the concentration of the entering reactant will be regulated.

The Ostwald theory was framed to meet the requirements of the case of the type reaction, but one encounters difficulties when an attempt is made to apply it as a general theory. Even when applied to the type case it seems inadequate. Since the concentration of hydroxyl ion falls off gradually and increases in the same way, one would expect a poor definition of the surfaces of the disc, both above and below. Precipitation would begin as soon as the solubility of magnesium hydroxide was exceeded, but the first precipitation would be meager, gradually increasing in quantity, however, to a maximum and gradually falling off in the same way. . An examination of the pictures accompanying K. Popp's article[12] will show that this was not the case in her experiments, and it was on the result of her

experiments that Ostwald based his theory. Her experiments were repeated by us and the results showed a series of discs, thin and tough.

Ostwald showed that the thickness of the discs decreased while the width of the spaces between them increased progressively. These exact results were not obtained in our experiments.

There are apparently two classes of rhythic precipitation: First, that in which the precipitate is found in all the bands, the chief difference between bands being the color of precipitate or its crystalline form[3]. Second, that in which strata of precipitate are separated by clear spaces.

While Ostwald's theory may be applied to the explanation of the second type, it is difficult to see how it can be applied to the first type at all. The case selected by Ostwald is a type in which one of the reactants is but little dissociated and its ionization is reversed by the presence of a common ion derived from one of the products. Silver nitrate and potassium chromate are both well ionized[1] and it is not likely that the presence of potassium nitrate in the reaction zone affects to any great extent the ionization of either reactant. It was found by us that the presence of potassium nitrate in high concentration in the solution of potassium ferrocyanide did not prevent the copious precipitation of copper ferrocyanide when copper nitrate was added.

TABLE I[1].

Exper. No. 1.1 External Reactant: KI 5 cc. 4% sol.
Date: 10/10/29 Internal Reactant· $Pb(C_2H_3O_2)_2$, 1:10
Gel: 4% gelatin

Band	Width of Band	Colors, etc.*
No. 1	23 mm.	Yellow, normal, 4 dark lines
No. 2	1 mm.	Green-Yellow, normal
No. 3	2 mm.	Yellow, normal
No. 4	2 mm.	Green-Yellow, normal
No. 5	2 mm.	Yellow, tint 1
No. 6	1 mm.	Clear Gel
No. 7	3 mm.	Yellow, normal
No. 8	1 mm.	Green-Yellow, normal
No. 9	4 mm.	Yellow, normal

*Colors were referred to Color Standard Sheets prepared for use in Mulligan's Identification of Pure Organic Compounds, Vol. 1, John Wiley & Sons, New York.

1. Note that only one clear space appears, and last band is widest.

A satisfactory general theory will do more than account for a few selected cases. It should be applicable to all. On this basis it seems to us that the Ostwald theory fails. The examination of a large number of data cards, containing particulars of many reactions resulting in stratified precipitates, give very little evidence in support of the theory that the results were controlled by diffusion waves. In Table 1 is given the results in the case of experiment No. 1.1. The gel was 4% gelatin (Eastman's ashless); lead acetate was the internal reactant and potassium iodide the external. 5 cc. of the latter was added to start the reaction which came to an end on the third day. There were in all 9 bands, clearly differentiated from each other by distinctly defined boundaries.

Of all the theories that have been proposed from time to time to account for the phenomena of rhythmic precipitation or stratification, that of Fischer and McLaughlin deserves special mention, but as far as we have been able to ascertain, has received very little[5]. Traube and Takahara have also developed a similar theory[13].

Freundlich[4] has likened the process of rhythmic precipitation to the flow of water through a tank, into which a stream of water runs steadily; the outflow, however, is controlled in such a way that it proceeds periodically. If it could be shown that the flow of the external reactant is interrupted periodically a cause for the different types of periodic precipitation has been found.

The authors of the membrane theory have observed that "all the materials which give satisfactory Liesegang's rings are such as form precipitate membranes in osmotic experiments[5]." "Semipermeable membranes are those which permit the diffusion of the solvent but not of the molecularly dissolved matter. They are solvated or hydrated membranes. When they are transformed to a less solvated form pores appear in them through which the solute, held back for a while, can again diffuse." "Freshly prepared semipermeable membranes are structureless. Their optical homogenity is at first the result of their fluidity and later of the amorphous state of the freshly-formed membrane. As the membranes age they finally become solid and crystalline."

TABLE II.

Exper. No. 3.7 External Reactant: KI 5 cc. 4% to 50cc. gel
Date: 10/5/29 Internal Reactant: $HgCl_2$, 5 cc. .1N;
Obsd. 10/12/29 Gel: 1% Agar

Band	Width of Band	Color, etc.
No. 1	4 mm.	Cloudy
No. 2	14 mm.	Orange, normal, dense, no cryst
No. 3	8 mm.	Orange, normal, globules
No. 4	3 mm.	Orange-Yellow, normal, few cryst
No. 5	1 mm.	Orange, normal, cryst, broken
No. 6	3 mm.	Orange-Yellow, normal, few cryst
No. 7	1 mm.	Orange, normal, cryst
No. 8	1 mm.	Orange -Yellow, normal, few cryst
No. 9	3 mm.	Red-Orange, 2 bands; dense red needles, with dense red lines above and below.

The truth of this final statement is supported by the note at the bottom of Table I in this paper and by observations on numerous other experiments. In one experiment in which KI was the internal reactant and $HgCl_2$ the external reactant in a silicic acid gel after three and one-half months, it was found that one of the lower bands, 22.5 mm. wide, was made up of alternating lines of crystals, sharp and distinct, 21 in number, separated by clear spaces. When these bands were first formed it was not possible to see crystals in the bands. The crystals were red orange, normal in color.

The diffusion of the external reactant proceeds steadily into the gel in accordance with diffusion laws. Since the concentration of the external reactant is always high, this will proceed even when the membrane is formed at a short distance from the top, and the concentration of this substance will rise back of the membrane. Water can of course pass through. In a short time the membrane becomes permeable, through crystallization or desolvation. When this occurs the stream issuing from the barrier has considerable pressure which is exerted in a direction away from the membrane. At this time its pressure is greater than that of the internal reactant on the other side of the membrane. As a result the precipitate, which at the time of its formation is probably of molecular dimensions, can move through the pores of the gel; in a short time, however, it has grown to colloidal dimensions and begins to halt in the pores.

In this way a semipermeable membrane is again formed, just as it may be formed in the pores of a porcelain cell in the case of an osmotic pressure experiment. The process of desolvation and crystallization will be effected in large measure by the presence of impurities in the gel and by the reaction products.

The anions of electrolytes have been arranged in a series in the order of their ability in affecting the desolvation of colloidal substances. This series, often called the lyotrophic or Hofmeister series[7, 8], has been studied by us in regard to their action on membranes and supporting gels, and the results will be published in another paper. In these studies the membranes were separated, washed clear of adhering crystals and examined. This was done in the case of a large number of substances producing rhythmic precipitates in gels.

TABLE III.

Exper. No. 1.36 External Reactant: $HgCl_2$ 5 cc. .1N
Date 10/5/29 Internal Reactant: KI, 2 cc. 4% to 50 cc
Obsd: 10/12/29 Gel: Gelatin 4%.

Band	Width of Band	Colors, etc.
No. 1	28 mm.	Cloudy
No. 2	4 mm.	Green-Yellow tint 1
No. 3	1 mm.	Orange, tint 1, faint
No. 4	10 mm.	Green-Yellow tint 1, few clear lines
No. 5	3 mm.	Orange. tint 1 on lighted side of tube Green-Yellow, tint 1 on unlighted side of tube
No. 6	2 mm.	Green-Yellow

H. N. Holmes[8] has made a very careful study of the process of crystallization from the surface of a membrane. He found that if he attached a piece of gold-beaters skin to the end of a tube so that it formed a porous boundary when it was placed in a vessel containing a saturated lead acetate solution, separating this from a .1N solution of potassium iodide, in a very few minutes, a very thin layer of almost amorphous lead iodide formed on the under side of the membrane, and then a continuous shower of beautiful crystals fell to the bottom. We think that this experiment throws light on the process of banding or periodicity in precipitates. If, as Fischer and McLaughlin have claimed, membranes are necessary for the formation of a banded precipitate, then the formation of a fine amorphous precipitate will be followed by a crystalline one and difference in structure and in color will be observed in the bands. Should the barrier yield suddenly to the solute, the precipitate formed at the face of the membrane will be swept away before it has time to grow to colloidal dimensions and clog the pores of the gel. The new membrane would be formed at a little distance from the first one and an open space would remain. (See Band 6, Table 1).

In this way a series of bands would be built up, and membranes of a fine amorphous layer and coarser crystalline layer would succeed each other until the precipitation ceased. (See tables). The process will cease when the membrane separates two reactants of the same concentration. In this case it often happens that the last band will be found to consist of a compact mass of greater thickness than the other bands. This is caused by a precpitation on the membrane, the reactants migrating in equal quantities from both sides of the barrier and precipitating there.

It is well known that manganese chloride reacts with silicic acid to form a membrane. Traube[14] has found that by dropping a crystal of that salt into an aqueous solution of silicate, a tree-like structure of manganese silicate is formed. At first a thin membrane is formed through which water can pass but not the solute. The osmotic pressure soon becomes great enough to rupture the membrane at some point. This gives rise to a new membrane and this in turn is broken apart. As the process is repeated over and over again it gives rise to a branched tree-like structure. If the formation of a membrane is essential to the formation of a stratified precipitate, it ought to be possible to produce banding in the precipitate when manganese chloride and a silicate are the reactants. To test this out, a solution of pure crystalline sodium silicate was formed of 1.06 specific gravity, and silicic acid was precipitated with acetic acid. When this had set to a gel, a solution of manganese chloride was placed on top. The experiments were conducted in duplicate. After standing about 48 hours it was seen that the precipitation in one case had ceased with the formation of the surface film. The other test tube exhibited a solid plug on top with no appearance of banding in it; but below it there was a series of bands alternately white and light brown in color. After two weeks several more bands were to be seen.

If one will examine the numerous microphotographs published in connection with the studies on this subject, he will see very good evidence of the formation of membranes in this type of reaction. They are quite visible. The very sharp outlines of the discs is evidence that there are distinct, continuous boundaries. It is very marked in the case of the silver chromate or mercuric iodide. In old experiments the discs are always found in the form of sharp lines of crystalline material. The microphotographs accompanying the article of Brodersen[2], published in Kolloid Zeitschrift, p. 21, volume 35, 1924, is especially good for this purpose. In all of them except the last, the last ring to be formed is seen to be devoid of crystalline structure as far as the range of the microscopic vision discloses it, while all the older ones have crystallization and show

distinct openings through which diffusion can take place without hindrance. Of course it is not necessary that pores visible under the microscope should be formed in order that the membranes should be permeable, but it is interesting to note that in the case of silver chromate and mercuric iodide, classical examples of substances that form periodic precipitates, we also have the best examples of membrane formation and of subsequent crystallization.

Summary

1. The Diffusion Wave Theory does not appear to explain all cases of rhythmic precipitation. It was framed to explain that class of reaction in which a precipitation zone is succeeded by a clear space. It does not account for the sharp outlines of discs, nor for the other class of precipitates where the bands are continuous. It fails to account for irregularities in precipitation.

2. The Membrane Theory, advocated by Fischer and McLaughlin, and later by Trabe and Takahara, seems to meet all the requirements. Membranes are formed by the substances reacting to form Liesegang's rings. They become permeable with age, often highly crystalline. Crystalization of the membrane can be seen in microphotographs of rings. They have been separated out from gelatin gels. The theory accounts for bands of different colors.

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EFFECTS OF ALCOHOL ON THE REPRODUCTIVE POWERS OF RATS (ALBINO)

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In January 1929, we started our experiments relative to the results of alcohol on the reproductive powers of albino rats.

EXPERIMENT I—F.

We took litter mates of a clean Wistar stock and allowed them to have one litter under normal conditions.

The female, known as F, cast a litter of 14 on Feb. 19. Four died. The ten living were six females and four males. These young were weaned at three weeks and the males removed from the cage April 1st.

On June 10th the males were returned to the cage and the litters as cast are recorded in the accompanying table for F2 generation.

I—F2

Rat	Date	No.	Wt. at birth	Wt. at weaning	No. surviving	
1	7/2	14	4.5 gms.	26.4 gms.	8	
2	7/3	10	--------	26.2 gms.	8	
3	7/8	9	--------	21.6 gms.	6	(16 females
4	7/9	8	4.62 gms.	--------	1	17 males)
5	7/9	14	4.35 gms.	26.7 gms.	7	
6	7/10	7	2.83 gms.	--------	3	
					33	Aver. 5.5

I—F.x

On March 26, the same pair of rats as used in Experiment I-f were mated but under the use of alcohol taken orally. This was force fed with a dropper, one cc. of 95% ethyl alcohol each day for seven days. At the end of this time we discontinued the feeding to the male but continued the daily feeding of the female until she dropped her litter of ten (6 males and 4 females) an April 20.

These were weaned at the age of three weeks and the males were removed June 22.

I—F.x2

On August 3 the males were placed with the females and the results of these matings are recorded in the accompanying table:

Rat	Date	No.	Wt. at birth	Wt. at weaning	No. surviving
1	8/26	12	4.8 gms.	All dead 8/30	0
2	8/27	9	4.8 gms.	All dead 8/30	0
3	9/11	4	--------	26.6 gms.	4
4	Pregnancy did not occur. The males were removed at 21 days.				
					Average 1.

In the above experiment rats No. 1 and No. 2 did not have any mammary gland reaction and the rats died for lack of food. Here would have been a chance to try prepared foods but we hoped for natural reactions which did not occur.

In the above cage was the female of the original pair, female F. She cast a litter of 8 on August 28. Five of these averaged 5.6 gms. at birth and all of the eight lived. One, however, was a cripple, the hind quarters seem to be partially paralysed and one side drops when the rat walks.

The female rat No. 3 of Experiment I—F.x2 was left in the cage with her sons and daughter and on Jan. 19 dropped a litter of two. One was dead when found and the other dying. There seemed to be an internal hemmorrhage underneath the skin at the base of her umbilicus.

The little female of the litter cast by rat No. 3 in Experiment I—F.x2, mated to one of her brothers, cast a litter of nine on Dec. 29th. At seven weeks these weighed in the average 72.8 gms as against 80.7 of the controls. See the control generation of Experiment II.

The feeding of all rats was exactly the same. The originals were fed corn, bread, milk, lettuce and table scraps for some time before the stock came to us. Our regular ration was 10 gms. of yellow unground corn, 5 gms. of whole wheat bread, 5 gms. of carrot root and 5 gms of carrot top and 10 cc. of milk per rat per day. Once a week 5 gms. of raw meat per rat was fed and table scraps and vegetable parings occasionally.

We reported the results of these experiments to Dr. Walter G. Eddy of Columbia University, who registered interest and asked us to repeat the experiment under as near the same conditions as possible.

EXPERIMENT II.

A pair of rats from the control generation of Experiment I was mated on November 3, 1930, and a litter was cast on December 3. At the age of three weeks all ten were living and averaged 23.4 gms. Weight at seven weeks, four weeks after weaning was 80.7 gms. The males were removed February 3 and returned March 7.

The results of these matings are recorded in the following table:

II—F2

at	Date	No.	Wt. at birth	Wt. at weaning	No. surviving
1	4/1	10	4.8 gms.	Eaten by mother	0
2	4/1	10	Fed when fd.	26.8 gms.	5
3	4/1	5	Fed when fd.	28.3 gms.	6
4	4/7	9	5.2 gms.	26.2 gms.	6
					17 Aver. 4.25

On January 17, we commenced to give the rats of the original pair of the above experiment, 1 cc. of 95% ethyl alcohol each day for seven days. The male weighed 275 gms., the female 210 gms. We continued to feed the male as well as the female on the alcohol not for any use in this experiment, but for future experimentation.

The female cast her litter of 10 (six females and four males) on February 13. These were weaned at three weeks and the males removed April 18th. The males were returned May 24th with the following results:

II—Fx

Rat	Date	No.	Wt at birth	Wt. at weaning	No. surviving
1	6/16	8	4.26 gms.	All dead 6/18	No milk from mother.
2	6/17	6	4.08 gms.	All dead 6/22	Very little milk but not enough
3	6/22	9	4.77 gms.	All dead 6/29	Milk as at No. 2
4	7/3	10	4.52 gms.	31.0 gms.	3
5	7/4	10	5.27 gms.	25.5 gms.	7
6	Sterile after being with male 21 days.				Average 1.5

The feeding and all other conditions were similar to those in Experiment I.

EXPERIMENT III.

The male of the above pair having had alcohol from January 17 to February 13, was placed with a female born October 30 of control stock who had four weeks previously cast a healthy litter of seven. On March 13th this female cast a litter of 5, three of which died during the day. One died March 23. The lone rat at three weeks of age weighed 17.1 gms. whereas our normal three weeks old rats weigh 21 to 26 gms.

The above experiments seem to indicate that alcohol lessens the reproductive powers of albino rats.

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